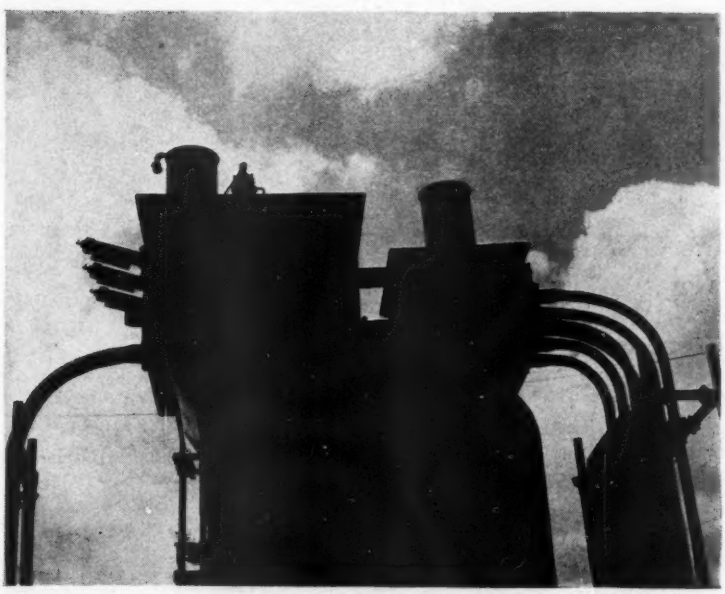
TWO SECTIONS
SECTION ONE

EDISON ELECTRIC INSTITUTE BULLETIN



Courtesy, The Detroit Edison Company

VOLUME II JANUARY 1934 NUMBER 1

STATISTICAL DATA OF THE ELECTRIC LIGHT AND POWER INDUSTRY

Compiled Monthly by the Edison Electric Institute—Covers 100% of the Industry

DURING THE MONTH OF NOVEMBER

	1933	1932	%
Kilowatt-hours Generated* (net)			
By fuel	4,449,526,000	3,815,706,000	+16.6
By water power	2,271,555,000	2,622,846,000	−13.4
Total kilowatt-hours generated	6,721,081,000	6,438,552,000	+ 4.4
Additions to Supply			
Energy purchased from other sources	203,818,000	211,319,000	− 3.5
Net international imports	73,248,000	30,409,000	+140.9
Total	277,066,000	241,728,000	+14.6
Deductions from Supply			
Energy used in electric railway depts	64,969,000	70,868,000	− 8.3
Energy used in electric and other depts	101,605,000	101,608,000	− 0.0
Total	166,574,000	172,476,000	− 3.4
Total energy for distribution	**6,831,573,000**	**6,507,804.000**	**+ 5.0**
Energy lost in transmission, distribution, etc.	1,115,802,000	1,084,554,000	+ 2.9
Kilowatt-hours sold to ultimate consumers	**5,715,771,000**	**5,423,250,000**	**+ 5 4**
Sales to Ultimate Consumers (kw-hrs)			
Domestic service	1,080,510,000	1,075,749,000	+ 0.4
Commercial—Small light and power (retail)	1,101,700,000	1,116,797,000	− 1.4
Commercial—Large light and power (wholesale)	2,862,335,000	2,577,808,000	+11.0
Municipal street lighting	196,794,000	206,691,000	− 4.8
Railroads—Street and interurban	352,749,000	349,584,000	+ 0.9
Railroads—Electrified steam	58,673,000	45,678,000	+28.4
Municipal and Miscellaneous	63,010,000	50,943,000	+23.7
Total sales to ultimate consumers	5,715,771,000	5,423,250,000	+ 5.4
Total revenue from ultimate consumers	$153,979,800	$156,861,500	− 1.8

DURING TWELVE MONTHS ENDING NOVEMBER 30th

Kilowatt-hours Generated* (net)			
By fuel	47,063,249,000	46,467,266,000	+ 1.3
By water power	31,622,772,000	30,945,358,000	+ 2.2
Total kilowatt-hours generated	78,686,021,000	77,412,624,000	+ 1.6
Purchased energy (net)	2,863,647,000	2,778,894,000	+ 3.0
Energy used in electric railway and other departments	1,910,907,000	2,100,075,000	− 9.0
Total energy for distribution	**79,638,761,000**	**78,091,443,000**	**+ 2.0**
Energy lost in transmission, distribution, etc.	14,230,981,000	13,754,006,000	+ 3.5
Kilowatt-hours sold to ultimate consumers	**65,407,780,000**	**64,337,707,000**	**+ 1.7**
Total revenue from ultimate consumers	$1,774,849,900	$1,846,836,400	− 3.9
Important Factors			
Per cent of energy generated by water power	40.2%	40.0%	
Average pounds of coal per kilowatt-hour	1.45#	1.49#	
Domestic Service (residential use)			
Average annual consumption per customer (kw-hr)	604	601	+ 0.5
Average revenue per kw-hr (cents)	5.50¢	5.59¢	− 1 6
Average monthly bill per domestic customer	$2.77	$2.80	− 1.1

BASIC INFORMATION AS OF NOVEMBER 30th

Generating Capacity (kw)—Steam	24,053,900	24,345,600	
—Water power	9,002,800	8,899,400	
—Internal combustion	460,600	451,100	
Total generating capacity in kilowatts	33,517,300	33,696,100	
Number of Customers			
Farms in Eastern Area (Included with Domestic)	(506,689)	(499,805)	
Farms in Western Area (Included with Com'l—Large)	(204,433)	(204,690)	
Domestic service	19,961,895	19,883,400	
Commercial—Small light and power	3,690,769	3,686,416	
Commercial—Large light and power	530,301	551,298	
All other ultimate consumers	66,145	68,938	
Total ultimate consumers	24,249,110	24,190,052	

*By courtesy of the U. S. Geological Survey with deductions for certain plants not considered Electric Light and Power Enterprises.

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EDISON ELECTRIC INSTITUTE BULLETIN

Volume II JANUARY, 1934 No. 1

THE ELECTRIC LIGHT AND POWER INDUSTRY AT THE BEGINNING OF ANOTHER YEAR

By GEORGE B. CORTELYOU

President, Edison Electric Institute

The demand by the public for electric service through the fourth year of a severe economic depression is, in my opinion, an outstanding feature of the electric light and power industry at the present time. That the public highly esteems the use of electricity is very apparent, for in spite of greatly reduced family incomes and the necessity for curtailing expenditures wherever possible, customers generally have continued their use of electricity. This is striking proof that electric service is rated by the consumer to be worth considerably more than he is paying for it. The average domestic customer in 1933 used even more electricity than he did in 1932, and *21 per cent* more than in the boom year of 1929.

Other developments of the year were discouraging. The most unfavorable development was the enormous extent of the increase in Federal and State taxes imposed.

The tax rate of the electric light and power companies, on the basis of gross revenue, was boosted to the extravagant amount of one third during the single year 1933. Taxes to be paid to Federal, State and local governments in 1934 are estimated at 40 per cent of operating income. Expressed in another way, the total tax bill of the electric light and power companies at the present time is equal to about 46 per cent of the total revenue from their domestic consumers. It is the equivalent of 2.6 cents on every kilowatt-hour sold by the electric light and power companies to their domestic consumers.

Aside from the enormous increase in taxes, the most disturbing development of the year was the launching of the Federal Government on a broad scale into the direct construction, or the loaning of money to districts or municipalities for the construction of generating, transmitting and distributing facilities for supplying electric energy to the public. This development has been undertaken at a time when the country is already supplied with cheap and dependable electric service and electric light and power companies have an uncomfortably large percentage of excess capacity which has caused them to seek every possible market for the sale of their product.

Another important development of the year just ended was the increase in payroll expense of electric light and power companies as an outcome of the enactment by Congress of the National Industrial Recovery Act. At the request of the Federal Government addressed to private electric light and power companies, payrolls were materially expanded by the adoption of shorter hours of work and higher rates of pay.

During this same period, rates for electricity have been substantially reduced. A measure of the extent of this reduction is furnished by the fact that sales of electric current for all classes of service for the year 1933 were 3 per cent greater than the sales for 1932, whereas the total revenue from ultimate consumers was 4 per cent less in 1933 than it was in 1932. Part of this reduction has been automatic through the increased use of electricity, particularly by industry. Rate schedules are so constructed that the greater the use of electricity the lower the average price. But a substantial part of this reduction has come about by reason of lowered rates.

In order to meet the urgent needs of industries which use electricity in their operations, rates to industrial consumers were materially reduced during the year. The average price per kilowatt-hour sold to industry reached during midsummer the lowest point in its history, except for a brief period during the war year of 1917. Rates to the domestic consumer continued their downward trend, dropping from 5.58 cents per kilowatt-hour at the end of 1932 to 5.48 cents at the end of 1933.

The added tax burden alone places a most serious handicap on private enterprise in competition with government owned enterprises, which escape taxes. At the present time electric light and power companies are selling approximately 95 per cent of the electricity used in the United States, notwithstanding the fact that municipal ownership of electric plants dates back to the same year, 1882, that the first privately owned central station was placed in operation. There have been established at one time or another 3,900 municipal plants in the United States and, according to the U.S. Bureau of the Census, there are still about 1,800 such plants. The net change in the number of municipal plants reported for the five year period 1927 to 1932 was a loss of 400 municipal plants.

It is not by chance that this enormous demand for electric service has grown up under private enterprise. The electric light and power companies are conscious of the fact that individually, and collectively through their trade associations, they have continued through many

(Continued on page 32)

MUNICIPAL AND PRIVATE ELECTRIC PLANTS—1932

A Summary of the U. S. Census of Electrical Industries

The U. S. Bureau of the Census has now released, in preliminary form, all of the important statistics on central electric light and power plants in the United States. The following statistics have been abstracted from these reports and comparisons have been made with the Censuses of 1927 and 1922, whose figures were compiled on a similar basis and under the same schedules with the same definitions.

TABLE I—NUMBER OF ENTERPRISES IN EXISTENCE AT END OF YEAR

	1932	1927	1922
Commercial	1,627	2,137	3,774
Municipal*	1,802	2,198	2,581

In this regard the Census states:

"The decrease from 2,137 to 1,627 in the number of commercial establishments during the five-year period (between 1927 and 1932) is due to the centralization of ownership or control and the absorption of independent generating stations accompanying the extension of transmission lines. The decrease from 2,198 to 1,802 in the number of municipal plants is due to the abandonment of municipal generating stations and the acquisition of municipal distribution lines by commercial systems." The change in the number of municipal enterprises from 2,198 at the end of 1927 to 1,802 at the end of 1932 is the net result of 572 establishments sold or gone out of business, and of 176 reporting for the first time to the Census. According to the Edison Electric Institute, 84 of these plants were established during this five-year period and the remainder were established before 1927 but reported to the Census for the first time; 1,626 identical establishments reported in both years 1927 and 1932.

The volume of business done by municipal plants is a little under six per cent of that done by the total electric light and power industry. On the basis of revenues received it is a little more than six per cent, because of the higher average rate for all power sold by municipal plants. Table II shows the ratio of the municipal plant figures to the grand total and the subsequent tabulations give actual details for each phase of the business.

Note: *For further details see E.E.I. BULLETIN, Nov., 1933, p. 231.

TABLE II—VOLUME OF BUSINESS DONE

Business Done by Municipal Plants, Expressed as a Percentage of the Total Industry

	1932	1927	1922
Generator Capacity	5.7%	5.5%	6.3%
Current Generated	5.0	4.5	4.7
Current Sold	5.7	4.8	6.0
Revenues	6.5	6.7	8.7
Arithmetical Average of the above	5.7%	5.4%	6.4%

1. Capacity of Generators—Kilowatts

	1932	1927	1922
Commercial	32,649,573	24,383,271	13,407,041
Municipal	1,974,495	1,428,034	906,397
Total	34,624,068	25,811,305	14,313,438
Mun'l is % total	5.7	5.5	6.3

2. Current Generated—Million Kilowatthours

	1932	1927	1922
Commercial	75,692	71,307	38,414
Municipal	3,965	3,379	1,878
Total	79,657	74,686	40,292
Mun'l is % total	5.0	4.5	4.7

3. Current Sold to Ultimate Consumers—Million Kilowatthours

	1932	1927	1922
Commercial	62,148	60,537	31,635
Municipal	3,748	3,076	2,019
Total	65,896	63,613	33,654
Mun'l is % total	5.7	4.8	6.0

4. Revenues Received from Ultimate Consumers

	1932	1927	1922
Commercial,	$1,703,303,728	$1,554,606,537	$869,885,000
Municipal,	117,801,796	112,439,034	82,754,000
Total,	$1,821,105,524	$1,667,045,571	$952,639,000
Mun'l is % total	6.5	6.7	8.7

Correspondence With E.E.I. Statistics

The preliminary figures released by the Census check, in general, reasonably well with the statistics already published by the Institute, with the qualification that the Census has included in its reports the data of certain manufacturing enterprises which the Institute has never considered as really being part of the electric light and power industry. Edison Electric Institute figures are based upon reports from some 400 operating companies and municipal electric plants, whose operations represent approximately 92 per cent of the entire industry and these figures are extended to 100 per cent. The closest correspondence between the Census and the E. E. I. is found in those states where the reporting companies represent the largest percentage of the total business.

TABLE III—AVERAGE REVENUES IN CENTS PER KILOWATTHOUR SOLD COMMERCIAL AND MUNICIPAL ENTERPRISES

	1932		1927			1922	
Class of Service	*Com'l*	*Mun'l*	*Com'l*	*Mun'l*		*Com'l*	*Mun'l*
Farm	2.8	5.6	2.0	6.8	(Lighting)	5.8	5.3
Domestic	5.6	4.7	6.9	5.5			
Commercial*	2.2	2.3	2.0	2.5	(Power)	1.8	2.0
Street Lighting	4.7	2.1	5.1	2.4			
Traction	0.9	1.1	0.9	1.1		1.0(a)	
Other Services	2.1	1.3	4.6(b)	5.5(b)		..	..
Total, all sales to consumers	2.7	3.1	2.6	3.7		2.7	4.1

(a) Average rate for all sales to traction enterprises by commercial and municipal plants combined; taken from 1922 Census of Electric Railways.

(b) Including, in 1927, energy "undistributed by class of service."

* A separation between "small light and power, retail" and "large light and power wholesale" was made for municipal plants for the first time in 1932. In 1927 these classes were combined and in 1922 a rough distinction was made between "light" (presumably including retail service) and "power" (presumably including wholesale service). In 1932, however, some inconsistencies still seem to exist, which make a comparison between commercial and municipal plants of doubtful value for these individual classes of service. It is clear from the figures of the following table (where the sales per retail commercial customer of municipal establishments are 60% larger than for commercial plants) that the classification of "small light and power, retail" extends into a zone of larger connected load and takes in considerably larger customers under municipal operation than under the rate schedules of commercial plants. The figures are therefore not wholly comparable and the two classifications have been combined in the table.

Current Sold per Customer, 1932. *(Kwhrs per year)*

	Commercial	Municipal
Small light & power (retail)	3,286	5,199
Large light & power (wholesale)	87,474	31,249
Domestic Service	600	708

Rate Comparisons

Table III shows the average prices received by private and municipal plants per kw-hr. of electricity sold. When all sales to ultimate consumers are taken together, the average price of municipal energy is 15 per cent above that of the private plants, to which should be added another 10 per cent because of the displacement of taxes.

In the case of domestic service, there is a difference of 0.9 cents in favor of municipal plants. When the amount of taxes displaced because of municipal operation is considered, this difference shrinks to but 0.4 cents. It will also be noted that in respect to domestic service the difference between municipal and commercial plants is steadily narrowing, being 1.4 cents in favor of municipal ownership in 1927 and but 0.9 cents per kwhr. in 1932. The item "farm service," combining as it does large users of irrigation pumping with ordinary farm uses, means very little as a measure of costs.

For the various geographic divisions, the 1932 Census figures give the averages shown in Table V for all electricity sold to consumers.

TABLE IV—AVERAGE REVENUES IN CENTS PER KILOWATTHOUR SOLD IF ALL TAXES WERE DEDUCTED
COMMERCIAL AND MUNICIPAL ENTERPRISES

	1932		1927	
Class of Service	*Com'l*	*Mun'l*	*Com'l*	*Mun'l*
Farm	2.5	5.5	1.8	6.7
Domestic	5.0	4.6	6.3	5.4
Commercial*	2.0	2.3	1.8	2.5
Street Lighting	4.2	2.1	4.7	2.4
Traction	0.8	1.1	0.8	1.1
Other Services	1.9	1.3	4.2(b)	5.4(b)
Total, all Sales to consumers	2.4	3.0	2.4	3.6

TABLE V—AVERAGE REVENUES IN CENTS PER KILOWATTHOUR SOLD—BY DIVISIONS—*1932*

	Commercial	*Municipal*	*Mun'l is higher than Commercial*
New England	3.4	3.9	15%
Middle Atlantic	3.0	4.1	37%
East North Central	2.8	2.8	—
West North Central	3.2	4.2	31%
South Atlantic	2.3	4.4	48%
East South Central	2.2	4.8	118%
West South Central	2.9	4.6	58%
Mountain	2.6	4.0	54%
Pacific	2.0	2.2	10%
Total U. S. A.	2.7	3.1	15%

TABLE VI—INCOME STATEMENT AND RATES OF RETURN *1932*

	Commercial		*Municipal*	
Revenues from Consumers	$1,703,303,728		$117,801,796	
Sales for Resale	150,805,781		3,392,650	
Misc'l Revenue	19,254,945		1,345,043	
Total Operating Revenues		$1,873,364,454		$122,539,489
Salaries and Wages	$303,058,039		$20,822,347	
Fuel	102,560,395		9,823,030	
Purchased Power	161,120,995		17,107,929	
Maintenance Expense	78,443,321		9,278,580	
Other Op'g Expenses	91,509,985		9,375,637	
Operating Expenses	$736,692,735		$66,407,523	
Uncollectible Bills	13,903,975		951,997	
Taxes	203,858,468		1,292,227	
Retirement Expense (a)	165,130,871		12,885,124	
Total Revenue Deductions		$1,119,586,049		$81,536,871
Operating Income		753,778,405		41,002,618
Rents		10,827,964		33,932
Balance of Income		$742,950,441		$40,968,686
Fixed Capital, Electric	$12,124,807,425		$539,569,527	
"Return" on Above	6.12%		7.59%	
"Turn-over of Capital"	Once in 6.5 yrs.		Once in 4.4 yrs.	
Ratio of Retirement Expense to Fixed Capital	1.36%		2.39%	
Ratio of Operating Expenses to Revenues	39.3%		54.2%	
Investment per Kw. of Generating Capacity	$371		$273	

(a) Includes $22,483,464 retirement appropriated from surplus for commercial plants and $1,485,329 for municipal plants.

COMMERCIAL NOTES

Electric Refrigeration Bureau to Continue

At a meeting of the Refrigeration Division of NEMA, held at Chicago on Jan. 10, the future of the Electric Refrigeration Bureau was one of the subjects for discussion. C. E. Greenwood, Commercial Director of the Institute, and G. N. Brown, Manager of the Electric Refrigeration Bureau, were invited guests and made presentations on the value of the Bureau and its accomplishments since the period of its formation.

A Resolution was passed by the Refrigeration Division for the continuation of manufacturer support until July 1. In the interim the needs of national coordination in the promotion of electric refrigeration and proposed further action will be under advisement.

Table Cookery to the Fore

The Residential Sales Subcommittee under the leadership of D. M. DeBard of Stone & Webster Service Corporation contemplates a program to promote the smaller heating and motor driven devices, especially those in the Electric Kitchen group. There would be coordination between the manufacturers, utilities and dealers, with national stimulation of local cooperative campaigns.

Bearing in mind that there are millions of domestic consumers with low average consumption, and whose present spending margins will not permit investment in the larger and more expensive load builders, it is opportune that we appeal to this class of consumer. The electric casserole, kitchen mixer, grill, toaster, waffle iron, etc., will offer services which will in the aggregate contribute to much needed revenue.

A program built along the lines of the lighting activity, with the possibility of a news medium, could not fail to

(*Continued on page 30*)

NEW RATES FOR DOMESTIC ELECTRIC SERVICE

Adopted by Georgia Power Company, Alabama Power Company, and The Tennessee Electric Power Company

By F. A. NEWTON

Commonwealth & Southern Corporation
Chairman, Rate Research Committee, E. E. I.

New rates for the domestic customers of Georgia Power Company became effective January 1, 1934, by an order of the Georgia Public Service Commission accepted by Georgia Power Company.

The new rates are a radical departure in rate-making for residence electricity and follow a similar plan and rates adopted recently in Alabama for Alabama Power Company. Similar new rates will become effective for the Tennessee Electric Power Company on February 1st.

Under the plan of rate-making adopted in Georgia, customers are not only given the benefit of an immediate rate reduction but what is more important in the long run, they are given an opportunity to use additional electricity at a very low rate. The plan thus permits any residence customer to earn *at once* a future low rate justified by increased use of electricity and greater volume of sales.

The plan requires no formal application by the customer. It is simple. There are no strings tied to it and it is entirely automatic as the customer will be billed under the low rate without having to exercise any option or make any application for it.

Two separate domestic rates are provided in the plan—an "Immediate" and an "Inducement" rate. These rates, together with the old rate which they supersede, are as follows:

Old Superseded Rate

$1.00 per customer, including 5 kwhr
6c per kwhr—next 25 kwhr
4.5c " " — " 25 "
3c " " — " 145 "
2c " " —over 200 "

New "Immediate" Rate

6.5c per kwhr—first 25 kwhr
5c " " —next 35 "
3c " " — " 140 "
1.5c " " —over 200 "

Minimum Charge $1.00

New "Inducement" Rate

$1.00 per customer including 15 kwhr
4.5c per kwhr next 50 kwhr
2c " " " 135 "
1¼c " " " 500 "
1c " " over 700 "

A comparison of monthly bills under the foregoing rates is shown below:

COMPARISON OF NET MONTHLY BILLS

kwhr per Month	*Old Superseded Rate*	*New "Immediate" Rate*	*New "Inducement" Rate*
10	$1.30	$1.00	$1.00
20	1.90	1.30	1.23
30	2.50	1.87	1.68
40	2.95	2.37	2.13
50	3.40	2.87	2.58
60	3.77	3.37	3.03
70	4.07	3.67	3.35
80	4.37	3.97	3.55
90	4.67	4.27	3.75
100	4.97	4.57	3.95
150	6.47	6.07	4.95
200	7.97	7.57	5.95
250	8.97	8.32	6.58
300	9.97	9.07	7.20
400	11.97	10.57	8.45
500	13.97	12.07	9.70
1000	23.97	19.57	15.20

While the rates of all residence customers were reduced by the new "Immediate" rate, all customers can get a still lower rate by taking advantage of the new "Inducement" rate. The benefit of the new "Inducement" rates is not limited to large users. Small customers will benefit as much, if not more than the larger users when they increase their use.

How does the plan work? How may the customer take advantage of the "Inducement" rate? A base bill is established for each customer for each month of the year. That base bill is the bill under the new "Immediate" rate when applied to the customer's use for the same month of 1933. For example, if the customer used 50 kwhr in January, 1933, his base bill would be $2.87 in January, 1934. If he used 60 kwhr in February, 1933, his base bill would be $3.37 for February, 1934.

If the same customer should use the same amount—50 kwhr—in January, 1934, his bill would be figured under the "Immediate" rate and would be $2.87. If he should use less than 50 kwhr in January, 1933, his bill would be figured under the "Immediate" rate. If, however, the customer should increase his use, that is another story. Suppose he uses 70 kwhr in January, 1934. In that case his bill would be figured under the "Inducement" rate and would be $3.35. He would thus obtain 20 additional kwhr for 48c. In other words, when the customer increases his use over the same month of 1933, he will be billed under the "Inducement" rate, if the bill under the rate is greater than his last year's use, figured under the "Immediate" rate. Or to put it in another way, no charge will be made for increased use over the same month of 1933 unless such increase is large enough to make his bill under the "Inducement" rate greater than his base bill for that month.

Suppose a customer who used 50 kwhr in 1933 adds a refrigerator and increases his use to 100 kwhr, the added 50 kwhr would cost him $1.08, the difference between 50 kwhr under the "Immediate" rate and 100 kwhr under the "Inducement" rate. This would be an average of 2.2c per kwhr for the increased use.

Suppose a customer who had a refrigerator in 1933 and used 100 kwhr per month adds a range and increases his use to 250 kwhr. The added cost of the current for the range would be $2.01, the difference between 100 kwhr under the "Immediate" rate and 250 kwhr under the "Inducement" rate. He would thus obtain the additional current at a rate of 1 1/3c per kwhr.

This plan of two rates, an "Immediate" and an "Inducement" rate while offering very low rates for increased use and holding out a very strong inducement for the customers to install additional appliances, will not, at the same time, reduce the company's revenue below the base bills, since the "Inducement" rate does not apply unless the customers exceed their base bills.

At the end of 1934, all base bills will be reduced 5 per cent and another 5 per cent at the end of 1935. At the close of 1936, the "Immediate" rate will be eliminated entirely and only the "Inducement" rate will remain. Thus the company is given an opportunity through building up increased sales to at least maintain and, it is hoped, increase its revenue while at the same time the customers using greater service are given *at once* the rate which will be applicable to all customers three years hence.

U.R.C. TYPE WEATHERPROOF WIRE FOR OVERHEAD CONDUCTORS*

During the past fifteen or twenty years the quality of weatherproof covering used for overhead line conductors has been subject to wide variations, and in the last ten years much of the covering has been unsatisfactory. These irregularities in quality led to a research at Purdue University under the auspices of the Utilities Research Commission, Inc., of Chicago, which resulted in the development of a satisfactory and economical weatherproof covering. The developments leading up to this new type of covering and the need for a revised American Standards Association standard to insure the furnishing of this quality of covering are outlined in this article.

Before the beginning of the past decade weather-resistant wire coverings were usually made from high-strength, long-fiber cotton yarn, saturated with natural asphalt; often the saturant was applied after each braid. Such coverings, while lacking in pliability, in general gave satisfactory service; that is, the coverings would remain intact and it would not be necessary to replace the conductors until required by system changes. The materials used and the manufacturing processes employed made the wire a rather expensive product. With the rapid growth of the electricity supply systems, enormous amounts of overhead line conductors began to be used about ten years ago, and changes in manufacturing processes and materials were then made to obtain lower cost coverings.

The wires having these cheaper weatherproof coverings gave very irregular performance. Many reports showed that some of the coverings would drip compound at summer temperatures, festoon and shed in only three or four years after installation, while other coverings had an indicated life of 10 to 15 years and more. Therefore, because of their appearance, in many instances it became necessary to replace the overhead line conductors a short time after they had been placed in service and long before it would have been necessary to replace the wires on account of changes in load or system. Another serious result was the loss in salvage value of wire removed after a few years or so of service, as frequently the condition of the covering made the wire unsuitable for reinstallation.

Because of this situation, about four years ago the Utilities Research Commission, Inc., sponsored a research project at Purdue University for the purpose of developing a uniform weatherproof covering of long life which could be produced at a reasonable expense and which would require little modification in materials and procedure at the factories.

Development of New Coverings

The principal lines of this investigation were as follows: first, the development of adequate means of comparing the life and quality of weatherproof coverings; second, experimental work with saturants of non-bituminous materials; third, the modification of commonly used weatherproof saturants to obtain greater resistance to flow at high temperatures, improved pliability, and improved weather resistance; fourth, investigation of the sources of asphalt for material possessing the most desirable characteristics.

Shortly after the research was started in 1929, the majority of the plants of the manufacturers of weather-resistant wire coverings in the United States were visited to observe the processes of manufacturing, to inspect the laboratories and to discuss the general problem with the plant engineers. These visits indicated that methods available at the plants were inadequate to determine the weather-resistant qualities of the coverings and saturants, and that there was only a meager knowledge of the reasons of failure and of means to increase the life. The procurement of complete testing equipment was shown to be of paramount importance in attacking the problem at Purdue University.

The standard Weather-Ometer, recommended and used for several years by the Bureau of Standards to determine the resistance of paints and other coatings to weathering agencies, was purchased and slightly modified for accelerated aging tests of short samples of covered wires. In this device an arc lamp with a Corex D glass globe, widely accepted as the nearest approach to direct sunlight, was used. The wires were mounted on the inside of a rotating drum and means were provided for a water spray over a portion of the wires. During each 24-hour period of the aging tests, the wires were subjected to (a) simultaneous exposure of light, heat, and water spray, (b) one freezing in a refrigerator, and (c) thawing and drying with exposure to the arc light again. The maximum intensity of each weathering element used did not exceed that found in actual service, but these maximum conditions were applied for several hours during each 24-hour period.

In order to test the saturants directly in an approved manner, aluminum plates were evenly coated with the saturants and subjected to the same weathering test cycle as used by the Bureau of Standards.

An outdoor exposure rack was employed where natural weathering of weatherproof wires could be observed. The wires on this rack were kept at 2300 volts above ground and carrying current.

The general order of merit of the saturants as obtained from the accelerated weathering tests on the wire samples was substantially the same as determined by tests on the saturants applied on aluminum plates, using the Weather-Ometer in the standard manner, and also by the tests made with wires installed on the natural weathering rack. The full details of the test conditions and results are contained in Research Bulletin No. 43, dated November, 1932, of the Engineering Experiment Station at Purdue University, Lafayette, Indiana.

In testing the asphalts, all of the standard physical tests common to the asphalt industry were used. Some of the equipment used in these tests has been improved upon as a result of these experiments; for example, the pliability tester has been made to perform its work automatically. Reliable physical test results were given by tests upon saturants obtained by pressing from the inner braids of weatherproof wire instead of by the use of solvents.

The research developed that the quality of the cotton yarn is not as important in producing a long-lived covering as is the saturant. The yarn should be sufficient to absorb and hold the saturant, and the outer braid should be closely woven to aid in preventing abrasion and erosion.

It was found that much of the trouble

*This article was prepared by Mr. D. W. Roper, sponsor of this subject under the Transmission and Distribution Committee, E.E.I.

with the inferior coverings was due to compounds having a low softening point; the compounds would flow readily at moderate summer temperatures from the top portion of the covering, thus permitting the exposed unsaturated cotton fibres to be rapidly rotted by the air and moisture. This deterioration was augmented in some cases by flaking away or evaporation of poor finishes, and also by the evaporation of the saturating compounds in hot weather due to the incorporation of waxes, fluxes, and other highly volatile materials into the saturating compound at the factory. To a lesser extent leaching (water solubility) of compound and miscellaneous causes were involved.

Since it was found that deterioration of the cotton braid was negligible as long as it was protected by a compound, the principal line of attack was directed to finding suitable saturants. In order to prevent migration in hot weather, a compound with a high softening point and increased resistance to flow was found to be necessary. The compound, however, could not be too brittle at low temperatures. These unusual requirements and several others of lesser importance were amply met by air-blown petroleum-base asphalts, unblended with other materials. Such asphalts are commercially procurable in large quantities at several points well distributed over the country. Experimental work with such materials as synthetic resins and enamels as saturants produced very high grade coverings; however, the use of these materials was not practicable on account of high costs. On the other hand, the use of air-blown asphalts as saturants is commercially feasible.

These air-blown asphalts are produced from the residue obtained in oil refining by the blowing of air through the heated residuum; whereas, the asphalts which had been heretofore used for weatherproof wire coverings were commonly produced by blowing with steam or if produced by air blowing, the blowing was not carried sufficiently far to provide the desirable physical properties.

It was found that the incorporation in the saturant of an inert mineral filler —an old practice with makers of roofing materials—was beneficial in increasing weather resistance and mechanical stability of the saturant. Still further improvement was obtained by the use of a tightly adhering coating of a finishing compound of improved physical properties and weather-resistance, together with a surface coating of mica flake. The natural weathering rack had shown that the present finishing waxes in common use were of little benefit since they either evaporated or cracked off within a short time after installation. Finishing materials should adhere to the underlying braids and should not flake off nor crack when the wire is bent.

The advantages of the new covering, known as the U.R.C. Type Weatherproof Wire, over the older types, particularly over the types manufactured in the past decade, were indicated to be as follows:

1. At high temperatures the saturant will not soften and shift to the bottom of the covering, nor is there undue loss in weight by evaporation of volatile matter.
2. The compound will not crack at low temperatures, and the covering when handled at low temperatures will not crack and become unsuitable for reinstallation.
3. The saturant has excellent resistance to weathering elements.
4. The new covering has a uniform long life and will not festoon following a few years of service.

One apparent disadvantage of using the air-blown asphalts is that either a longer saturating period or an increase in the temperature of the saturant is required at the factories. As the latter method would result in the least expensive change in plant operation, a number of tests were made to determine whether or not the increase in temperature would have any damaging effect upon the cotton braid and upon the copper wire. The tests showed that the higher temperatures did not damage the yarn materially and that, except for the few old style "reel in and reel out" saturating tanks still in use, the copper was not in the tank long enough to anneal the conductor. Hence, the effect of higher temperature was negligible.

Production of New Type of Covering

Shortly after the completion of the work in the laboratories of Purdue University several manufacturers, upon request for the wire, made suitable modifications and additions to their equipment for the commercial production of this new type of weatherproof covering and made investigations of their own regarding the saturating and finishing materials. As a result, the new U.R.C. Type Weatherproof Wire is now in production by several manufacturers and others expect to start production shortly.

Already over one hundred light and power companies, municipal plants, railroad and communication companies have installed this type of wire in various parts of the country. The users reporting on their experience have advised that the wire seems to be a great improvement over the older types of wire. Some of the users have made arrangements to observe the installed wire and to obtain samples periodically for examination and tests.

Specifications

The initial commercial use of the new weatherproof covering was with 90,000 pounds of wire made on an experimental order. It was proven that the use of the new saturant in weatherproof coverings was commercially feasible. On the basis of the information obtained incidental to this experimental production, and after extensive conferences of manufacturers, some large utilities, and representatives of the Utilities Research Commission, specifications for the U.R.C. Type Weatherproof Wire were prepared. These specifications were a revision of the specifications incorporated in the Research Bulletin of Purdue University and the main revisions consisted in the modification of some of the test requirements and in some of the commercial requirements.

It should be noted that the use of the specifications alone without the aid of proper inspection does not insure the high quality of weatherproof wire contemplated by these specifications. Visual inspection will not, for example, indicate whether or not the properties of the saturant and the performance of the wire in bending test at 32° F are satisfactory.

Because of the more severe acceptance requirements, *wire made and inspected in accordance with these specifications for U.R.C. wire meets the existing A.S.A. and many private specifications by an ample margin.* With slight changes to meet special braiding requirements, this wire meets any weatherproof specification in use in the United States.

The A.S.A. Technical Committee which prepared the present American Tentative Standard Specifications for Weatherproof (weather-resisting) Wire and Cable, C 8kl, 1932, has been reorganized and has undertaken to prepare a new American Standard for weatherproof wire to be known as the U.R.C. type. The original specifications for U.R.C. type wire formulated at Purdue University and somewhat modified by later experience is under consideration by this Committee.

The Transmission and Distribution Committee, E.E.I., recommends to the member companies of the Institute that they obtain some of the U.R.C. type weatherproof wire, which will readily

(Continued on page 8)

CHAIRMAN DAVIDSON REVIEWS PAST YEAR'S ACTIVITIES OF ELECTRIC REFRIGERATION BUREAU

Congratulates Industry on Impressive Sales Record and Sees Bright Prospects for 1934—Record Number of Entries in Holiday Display Contest

Congratulating the electric refrigeration industry on the impressive sales record which it established in 1933, James E. Davidson, Executive Chairman of the Electric Refrigeration Bureau, in a statement issued at the beginning of the new year, reviews the activities of the Bureau in their relation to the success achieved.

Mr. Davidson says:

"The electric refrigeration industry enters the new year under conditions which offer a sharp contrast to those which marked the beginning of 1933. To look back upon those first few weeks of last year would be exceedingly unpleasant were it not for the fact that, as we now know, they marked the turning point from which one of the most remarkable records in the annals of American industry has been achieved. The figures, as issued month by month, tell an eloquent story, and congratulations are due to all those who contributed in greater or lesser degree to the impressive record.

"The upturn started in April. By the end of May it had gained such headway that a new record for the year already seemed in the making. June broke May's all-time record for a single month and for the four successive months ending with October, all comparative monthly sales records of previous years were broken. Including a conservative estimate for November and December, the sales for the year reached the approximate total of 1,050,000 units, 100,000 more than in the previous peak year, 1931.

"With the industry entering the new year under such headway, and with the saturation even now approximately only 24 per cent, it would seem that the prospects for a new record in 1934 are extremely bright. Still, fine as was the achievement of last year and bright as the new year's outlook seems to be, one's mental reactions resolve themselves into a dizzy whirl when one tries to contemplate what might have been accomplished, and what might still be accomplished, with more intensively organized effort devoted to cooperative sales promotion activity.

ELECTRIC REFRIGERATION BUREAU
SALES—HOUSEHOLD MODELS ONLY—FIRST ELEVEN MONTHS 1933

	YEARS QUOTA	ELEVEN MONTHS' QUOTA—96%	ESTIMATED TOTAL SALES	% QUOTA REALIZATION
New England Division				
Connecticut	15,316	14,703	17,200	116.9
Maine	6,234	5,985	5,485	91.6
Massachusetts	39,027	37,466	51,962	138.6
New Hampshire	4,009	3,849	3,767	97.8
Rhode Island	6,435	6,178	8,947	144.8
Vermont	2,626	2,521	2,681	106.3
Eastern Division				
Delaware	1,607	1,543	2,277	147.5
Maryland & D. C.	15,944	15,306	26,457	172.8
New Jersey	39,021	37,460	48,521	129.5
New York	123,949	118,991	197,421	165.9
Pennsylvania	68,754	66,004	100,634	152.4
East Central Division				
Kentucky	8,934	8,577	14,186	165.3
Ohio	51,228	49,179	66,924	136.0
West Virginia	6,149	5,903	9,978	169.0
Middle West Division				
Iowa	15,232	14,623	13,427	91.8
Kansas	11,343	10,889	11,851	108.8
Missouri	22,078	21,195	36,145	170.5
Nebraska	7,837	7,524	8,392	111.5
Pacific Coast Division				
Arizona	2,295	2,203	2,342	106.3
California	62,735	60,226	59,847	99.3
Nevada	569	546	1,001	183.3
North West Division				
Idaho	2,582	2,479	2,266	91.4
Montana	2,785	2,674	3,374	126.1
Oregon	7,893	7,577	7,071	93.3
Utah	3,850	3,696	4,362	118.0
Washington	14,270	13,699	11,692	85.3
South Eastern Division				
Alabama	5,470	5,251	9,559	182.0
Florida	7,687	7,379	9,962	135.0
Georgia	6,537	6,275	11,462	182.6
North Carolina	8,601	8,257	13,769	166.7
South Carolina	3,427	3,290	5,436	165.2
Tennessee	7,830	7,517	9,565	127.2
Virginia	8,733	8,384	15,003	178.9
Great Lakes Division				
Illinois	61,455	58,997	70,742	119.9
Indiana	22,386	21,491	22,154	103.0
Michigan	35,191	33,783	31,903	94.4
Wisconsin	20,689	19,861	17,558	88.4
North Central Division				
Minnesota	15,809	15,177	14,448	95.1
North Dakota	1,996	1,916	1,806	94.2
South Dakota	2,558	2,456	2,445	99.5
Rocky Mountain Division				
Colorado	6,745	6,475	8,302	128.2
New Mexico	1,091	1,047	1,662	158.7
Wyoming	1,045	1,003	1,354	134.9
Southwestern Division				
Arkansas	3,664	3,517	5,402	153.5
Louisiana	6,525	6,264	7,323	116.9
Mississippi	2,742	2,632	3,221	122.3
Oklahoma	8,346	8,012	12,053	150.4
Texas	20,941	20,103	35,932	178.7
Totals	802,170	770,083	1,029,271	133.6

"The Electric Refrigeration Bureau can look back upon the past year with pardonable pride in its accomplishments under most trying conditions. In saying that money has been exceedingly scarce I am only stating what everybody knows and what everybody is probably tired of hearing. Yet the 400 local bureaus which constitute our organization have carried on in defiance of depression and discouragement. Under the guidance and with the assistance of the national Bureau local cooperative activities, locally financed, have been maintained. Budgets have been necessarily curtailed in many instances, yet the year's expenditures for these local activities have been sufficient to raise the total for the three years of the Bureau's existence to upwards of $5,000,000, approximately one-half of which sum has been contributed by local utility companies.

"Nor has money been the only contribution of the central stations to the Bureau activities. In almost all of the 400 local bureaus they have been the moving force in the cooperative program, providing local chairmen from their personnel, taking the initiative in all matters of organization, arranging for meetings and donating the use of their showrooms and auditoriums for cooperative exhibits.

"To the credit of the local bureaus I wish to record the fact that they were undaunted throughout those first ten weeks of 1933 which in retrospect stand out as probably the darkest period in our country's industrial history. They faced the situation with courage and planned for the future. Meetings were held, funds were raised and between the first of March and the end of May electric refrigeration shows were held in hundreds of communities.

"Impetus was given to these and other local activities by the national Bureau through its Legion of Honor Contest which was designed to give fitting recognition to outstanding individual accomplishments in local cooperative organization and sales promotional effort. The data submitted to the New York office of the Bureau in behalf of those selected in their respective communities as candidates for these regional honors proved a veritable revelation in their story of enterprise, ingenuity and, in many cases, downright pluck in the face of apparently insurmountable obstacles.

"Electric Refrigeration Week, Sept. 30 to Oct. 7, found some two hundred cities in all sections of the country participating in this annual Bureau-sponsored event. Entrants in the contest to determine the most successful shows reported almost without exception larger attendance, greater public interest and a larger number of sales and prospects than marked the Fall Shows of either of the two preceding years.

"Complete information as to the extent of participation in the recent Christmas Holiday Window Display Contest is not yet available. However, entries began coming in the first of December and I am confident that when the returns are all in it will be found that there was wider cooperation in this activity on the part of distributors, dealers and central stations than ever before. The offering of a special prize of $100 to be awarded the local Bureau having the largest representation of contestants in proportion to the number of retail sales outlets was expected to arouse a maximum of interest throughout the country.

"The work of the central organization in New York has been handled energetically and efficiently. Through lack of sufficient funds, a condition imposed by the economic situation, it has been impossible to maintain what might be termed an ideal national program for a cooperative campaign which possesses the potentialities which this one holds. The ideal program would include a succession of nationally sponsored activities covering a large part of the year, backed by a comprehensive but not too ambitious campaign of national advertising. In the absence of such a program the New York office has maintained the closest possible contact with local chairmen, calling attention to approaching activities, offering suggestions and passing on ideas which had proved fruitful of results in other communities, and offering encouragement where interest seemed to be lagging.

"Our limited field force has covered a large amount of territory with most gratifying results, not only from the standpoint of the Bureau but also from that of the communities served. No fewer than 194 electric refrigeration meetings, held in more than thirty states, have been addressed by Bureau representatives in the past year. This means that there has been an average of two such gatherings held every three business days throughout the year. The attendance of dealers, distributors and central station representatives at these meetings has averaged over one hundred, and reports as to the immediate benefits derived have been unanimously favorable.

"For the cooperation of the refrigeration and electrical trade press during the past year we are genuinely grateful. The Bureau's messages to the trade have been given commanding prominence in the editorial and news columns of the leading publications, week by week and month by month, and the support thus accorded has proved a valuable complement to the Bureau's campaign of general publicity calculated to keep the public aware of the advantages of electric refrigeration.

'In closing this brief résumé of the Electric Refrigeration Bureau's third year of activity I again wish to extend my sincere thanks to the members of the Bureau's Executive and Plan committees and to all those who have given so generously of their time and energy in serving as regional, state and local chairmen in our organization. They have not only served the Bureau well but have been most loyal in their personal support of the national chairman. For this support I am indeed grateful."

RECORD LIST OF ENTRIES IN HOLIDAY WINDOW DISPLAY CONTEST

The largest number of entries ever recorded in the Bureau's annual Christmas Holiday Display Contest have been received in the competition covering the holiday period just passed. On Jan. 2 more than one hundred dealers and central stations had filed their entries, with accompanying photographs, at the New York office. With Jan. 12 as the closing date for entries, it was expected that this number would be largely increased, with practically every state in the Union represented. The names of the winning contestants will be announced in the February issue of the BULLETIN.

U. R. C. Type Weatherproof Wire

(Continued from page 6)

pass the A.S.A. specifications. By so doing, the companies can obtain some practical experience with this type of wire and, if desired, make some tests of their own, in order that they will be in a position to inform the Committee regarding their practical experience with U.R.C. type wire. The Committee will then, in turn, be in a position to advise their representative on the A.S.A. Committee when this proposed specification appears for final adoption.

Martin Prize Paper

ACCOMPLISHMENTS IN RURAL ELECTRIC DEVELOPMENT BY ALABAMA POWER COMPANY DURING 1932*

Agriculture in Alabama

As the extension of electric lines and the uses of electric service on the farm are affected by the type of agriculture and the farm's cash income, a brief description of agriculture in Alabama is presented with particular reference to those conditions that have a direct effect on rural electrification.

Alabama has a wide variety of soil types, most of which are well adapted to the development of high production of many different crops. It has an average annual growing season ranging from 325 days in the extreme southern portion of the State to 200 days in the northern part. The annual rainfall varies from an average of 49.1 inches in the northern part to 61.8 inches in the area adjacent to Mobile, in the southwestern part of the State.

The soil and climate are well adapted to the production of cotton. And prior to the advent of the boll-weevil and the conversion of the cattle ranges of Texas and Oklahoma into cotton fields, the production of the fleecy staple resulted in the development of many prosperous plantations and constituted a large per cent of the State's agriculture. At that time there was plenty of uncleared and virgin land to develop as the production of cotton depleted the fertility of the cultivated fields. There was no immediate necessity for maintaining the soil fertility and, as a result, the cultivated soils were generally depleted.

While there has been some tendency toward a diversified agriculture since the advent of the boll-weevil, cotton is still the major item of agricultural production, and only within the last few years has there been any general effort to restore the fertility of the depleted soils.

According to the 1930 Census, the number of the different types of farms in the State were as follows:

Type of Farm	*Number*	*Per Cent of Total*
All Types	257,395	100.00
General	13,220	5.15
Cash Grain	90	0.03
Cotton	206,835	80.50
Crop Specialty	2,620	1.20
Fruit	951	0.37
Truck	923	0.36
Dairy	1,541	0.60
Animal Specialty	938	0.36
Stock Ranch	261	0.11
Poultry	746	0.28
Self-sufficing	12,941	5.05
Abnormal	6,929	2.68
Unclassified	9,400	3.65

In 1930, of the 257,395 farms in the State 90,372 were operated by owners, of which 15,228 were only part owners, leaving only 75,144 farms operated by full owners. Tenants were operating 166,420 or 64.7 per cent of the total number of the farms in the State. Of the tenant farms, 48,707 paid cash rent; and 117,713 or 71 per cent were either sharecroppers or paid rent with a percentage of crops produced. Of the total farms in the State, 163,566 were operated by white farmers in 1930, and 93,829 or 36 per cent were operated by negro farmers.

According to statistics of the Agricultural Yearbook of 1932, Alabama ranks forty-fifth in the average income per farm for the year 1930, the average being $458 per farm, while the average for California, the first in rank, is $4,184 per farm.

History and Description of Rural Electric Development by the Alabama Power Company

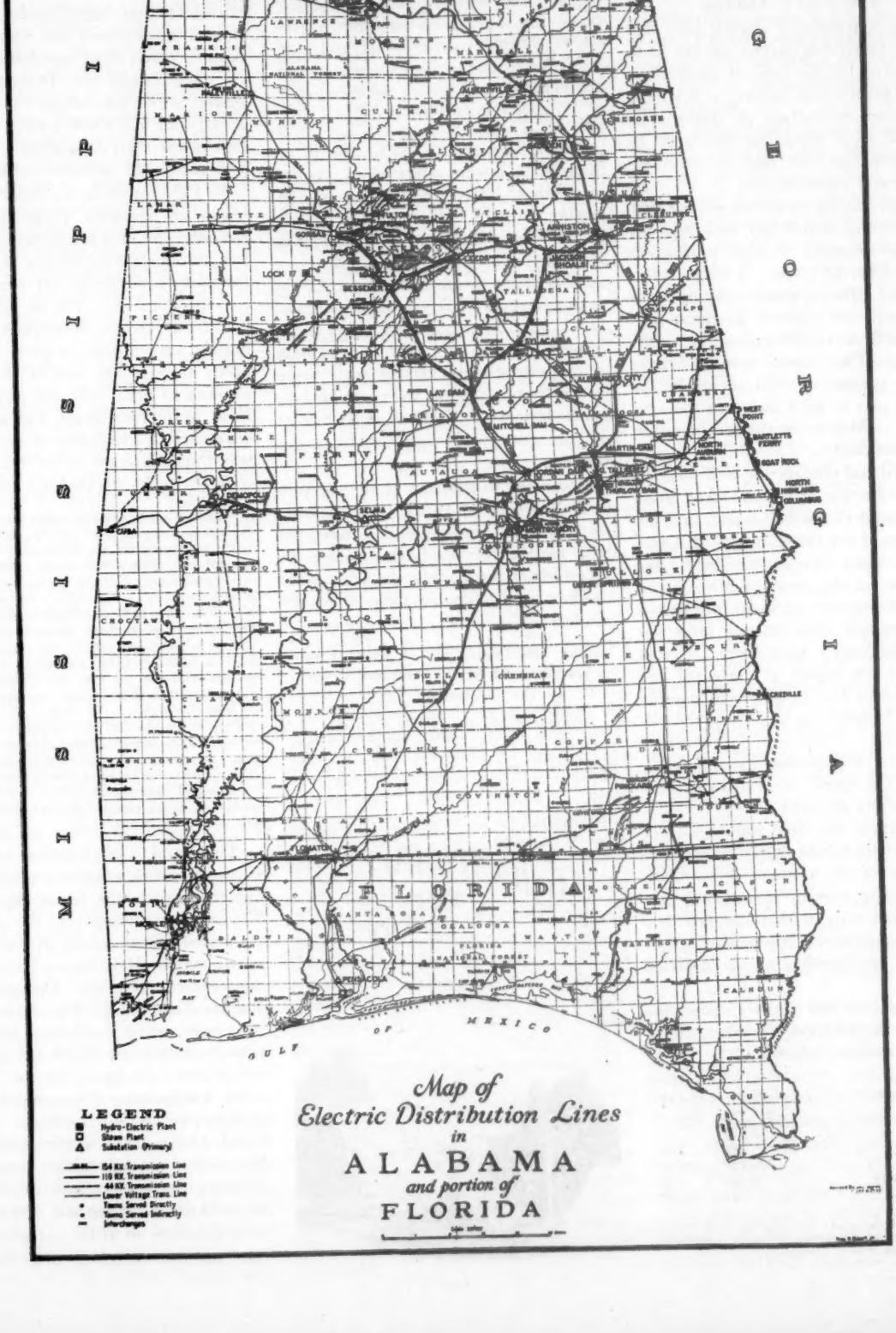
According to the 1930 Census, 71.9 per cent of the total population of Alabama is rural; there is only one city within the State with population of 100,000 or more; there are only 53 incorporated places with populations of 2500 or more; there are 143 incorporated places with populations of less than 2500; and 1,721,498 people, or 65 per cent of the total population of the State, live outside of incorporated places.

In 1924 the Alabama Power Company began an intensive program of rural electrification, for the purpose of making the conveniences of electric service more generally available to the rural population of the State, and in an effort to assist in further development of the State's agricultural progress and prosperity through the uses of electricity as a source of light, heat and power on the farm, in the rural home, and in the rural community. The policy of the Company was thus expressed in the report of the company to its stockholders for 1925:

"We are all dependent upon the farmer for the necessaries of life and he lacks this important agency in his household and living conditions. Industry has the motor in the cities and towns, but the farmer will find that it also reduces his cost of operation, and that it will in the end contribute toward making his industry profitable. If those who live in the rural sections, therefore, will do their part in advancing the use of electricity, just as the users in the city are doing, then the farmer will find the same service available to him throughout the State. We have not waited upon the full development of the use of electricity before bringing it to the farmers, but we are engaged in this pioneer work in hope that its benefits and advantages will recommend themselves as the work goes on, and thus make electric service permanent in our rural sections."

The rural electrification work was started as an experimental project in cooperation with the State Agricultural Experiment Station of the Alabama Polytechnic Institute, the National Committee on the Relation of Electricity to Agriculture, and the Alabama Farm Bureau Federation. The Power Company constructed rural lines for a field laboratory for the field investigations which were conducted by the Agricultural Engineering Department of the Alabama Polytechnic Institute. The National Committee on the Relation of Electricity to Agriculture assisted in planning the project, and the Alabama Farm Bureau appointed a committee of farm members to assist and advise with reference to the plans and results of

*Abstract of the paper winning the 1933 Thomas W. Martin Rural Electrification prize. Submitted by the Alabama Power Company.


TENNESSEE
MISSISSIPPI
GEORGIA
FLORIDA
GULF OF MEXICO
LEGEND
Hydro-Electric Plant
Steam Plant
Substation (Primary)
154 KV. Transmission Line
110 KV. Transmission Line
44 KV. Transmission Line
Lower Voltage Trans. Line
Towns Served Directly
Towns Served Indirectly
Interchanges
Map of
Electric Distribution Lines
in
ALABAMA
and portion of
FLORIDA

the work. This work resulted in the necessary information to design a rural rate and to begin a constructive program of rural electric development throughout the territory served by the company.

In Exihibit No. 1 is presented a chart showing the growth of rural electric development by this company from 1923 through Dec. 31, 1932, as to the number and miles of rural lines, the number of rural customers, and the annual kilowatt-hour sales from rural lines.

A rural line is defined by this company as "A distribution line of 11,000 volts, or less, outside the incorporate limits of any town, serving less than 20 customers per mile of line." The shaded sections of the exhibit represent lines that have been built by the company as rural and have since developed to the extent that they have been transferred from the rural classification. While these lines are no longer considered as rural, they are included in the exhibit as indicative of the fact that electric service has aided in the development of these communities.

On the opposite page is a map of Alabama, showing the distribution of rural lines throughout that part of the State served by this company. With a few minor exceptions, the dotted lines, keyed on the map as lower voltage transmission lines, represent the lines classed as rural.

In addition to those lines that have been built as rural, the company is serving 117 small farming community centers with populations of 700 or less. According to the 1930 Census, the total population of these communities is 43,987; and the company is serving approximately 7850 customers in these communities that are only trade centers for adjacent farms but have not been classed as rural lines by the company.

As a result of the company's rural-line development and the extension of electric service to the smaller communities of the State, electric service is generally distributed over the entire area served by the company, and at present practically all the farms within the area are within reach of a source of electricity from the standpoint of distribution voltage and facilities.

In Exhibit No. 2 the number and miles of rural lines are listed by counties, including only those lines that are at present classed as rural. This list indicates further that the company's rural program covers the entire area of the State served by it, which does not include the south-central part of the State and several smaller sections in Baldwin, Monroe, Washington, Clarke, and other counties.

Organization for Conducting Rural Electric Development

The company's organization for conducting the rural electric program is shown by diagram in Exhibit No. 3. The organization consists of five agricultural engineers in the division offices. These men are experienced and trained in the agriculture of the South and have had special training to equip them further for handling field problems pertaining to rural electric service. These men conduct their work under the direction of the division manager and with the supervision of a chief agricultural engineer, of the company's main office, who is in the Rural and Towns Division of the Sales Department.

The agricultural engineers' work is to assist presently-served rural customers with their problems pertaining to their uses of electric service, to advise with them as to how they can obtain the greatest value from their service at the minimum cost, and to assist prospective customers in their efforts to get electricity. They do not sell or receive any commissions from the sale of equipment, but they analyze the farmer's operations and advise him as to how he can use electric service, about what the kilowatt-hour consumption would be for the operation,

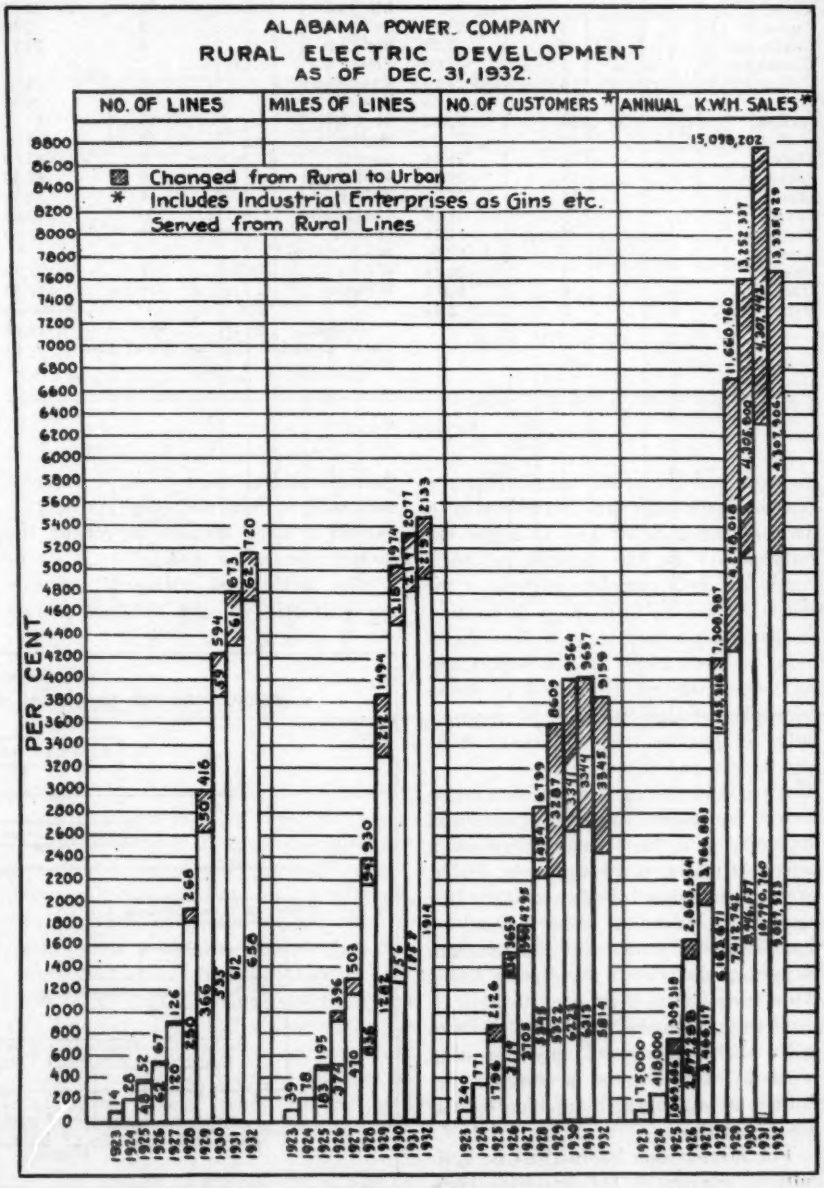

ALABAMA POWER COMPANY
RURAL ELECTRIC DEVELOPMENT
AS OF DEC. 31, 1932.
NO. OF LINES
MILES OF LINES
NO. OF CUSTOMERS *
ANNUAL K.W.H. SALES *
Changed from Rural to Urban
* Includes Industrial Enterprises as Gins etc. Served from Rural Lines
PER CENT
15,098,202

Exhibit No. 1

DISTRIBUTION OF RURAL LINES BY COUNTIES
AS OF
DECEMBER 31, 1932

County	Number Lines	Miles	County	Number Lines	Miles
Autauga	9	23.80	Houston	5	20.68
Baldwin	10	6.54	Jackson	13	30.69
Barbour	5	23.27	Jefferson	90	207.83
Bibb	3	5.81	Lamar	2	10.45
Blount	8	35.90	Lauderdale	9	45.74
Bullock	7	30.47	Lawrence	3	15.98
Butler	4	13.00	Lee	8	11.85
Calhoun	17	53.40	Limestone	12	63.67
Chambers	6	20.50	Lowndes	5	31.72
Cherokee	4	13.40	Macon	4	9.76
Chilton	15	64.15	Madison	16	75.06
Choctaw	5	27.13	Marengo	8	25.22
Clarke	3	12.86	Marion	2	13.07
Clay	1	1.70	Marshall	15	56.17
Cleburne	3	5.31	Mobile	76	151.58
Coffee	1	9.00	Monroe	6	25.24
Colbert	5	11.30	Montgomery	37	125.62
Conecuh	..	..	Morgan	16	36.86
Coosa	3	23.70	Perry	3	2.30
Covington	1	1.20	Pickens	4	20.96
Crenshaw	1	2.00	Pike	..	..
Cullman	6	24.90	Randolph	1	14.00
Dale	3	2.65	Russell	6	26.45
Dallas	14	16.72	St. Clair	16	45.71
DeKalb	19	77.20	Shelby	18	43.01
Elmore	24	59.76	Sumter	5	12.73
Escambia	15	29.34	Talladega	9	13.30
Etowah	15	23.37	Tallapoosa	4	8.56
Fayette	2	1.30	Tuscaloosa	20	40.73
Franklin	4	14.35	Walker	12	10.60
Geneva	3	15.70	Washington	..	..
Greene	5	20.28	Wilcox	1	7.30
Hale	8	20.82	Winston	1	17.65
Henry	2	2.85			
			Total	658	1,914.17
			Total Counties Having Rural Lines		64
			Total Counties in State		67

Exhibit No. 2

its costs and the other factors that the farmer should take into consideration in deciding whether or not to make the installation. By the agricultural engineer's making a complete analysis of the operations on the farm, he is in position to advise the former correctly and thereby avoid the expense to the farmer and to the company of ill-adapted or uneconomical installations, and to promote only installations that will prove to be satisfactory and economical.

After determining that an installation would be economical, the agricultural engineer, with the farmer's permission, refers the matter to an equipment dealer, or to a salesman of the company for equipment sold by the company, and assists both the farmer and the salesman in getting the correct installation made. After installations are made, the agricultural engineer makes occasional visits to assist the farmer with any operating problems, and thereby prevents many failures of equipment by making operating adjustments.

The farmer soon learns that the agricultural engineer is his consulting engineer; and the salesman recognizes that the agricultural engineer is of material assistance to him not only in the promotion of sales but also in getting the correct installation made.

The agricultural engineers' activities are conducted through personal contact with individual customers and through community meetings conducted in cooperation with county agricultural agents, home demonstration agents, vocational agricultural teachers, and other established and active agricultural agencies in the local communities.

During 1932 the five divisional agricultural engineers of the company made 5429 visits to individual customers served from rural lines and interviewed 902 prospective customers who requested service during the year. They conducted 14 meetings in rural communities served by rural lines for the purpose of calling to the customers' attention some of the ways that electric service can be and is being used to pay its own way in the rural home and to increase the income on the farm. These meetings were attended by 1935 rural people; and they consisted of a moving picture illustrating uses of electric service, and a brief discussion, by a company agricultural engineer, of profitable uses of electricity on Alabama farms. In each community the meeting was followed with personal contact by the agricultural engineer, calling to the attention of individual customers how they could make money by the use of electric service in their operations.

Especially in view of the average cash income on Alabama farms, it is quite apparent that for electric service to be generally satisfactory and of the maximum advantage to the rural people it must not only provide the desired conveniences but it must also be used in such ways that it will result in an increased income amounting to at least as much as the cost of the service to the

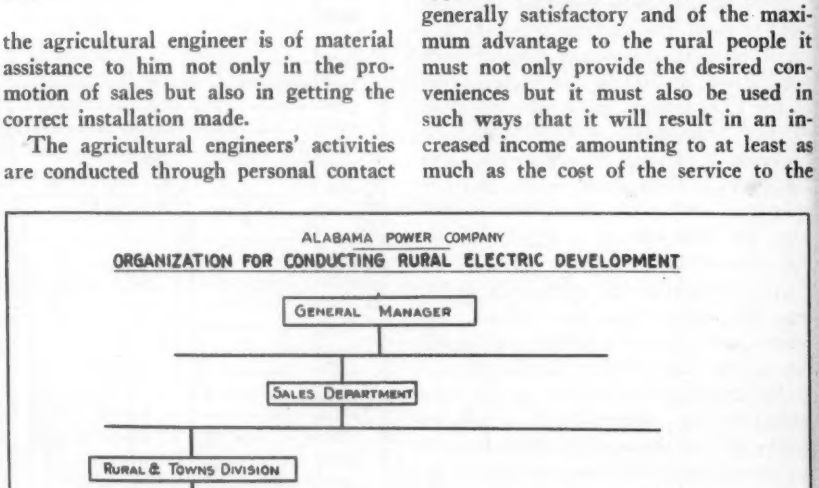


Exhibit No. 3

customers. Therefore, the company's activities and plans for conducting the rural electric development have been designed and conducted on the basis that electric service must increase the prosperity of rural customers and rural communities.

The agricultural engineers' activities are confined to existing customers and to prospective customers who are located immediately adjacent to the company's lines. All surveys of proposed lines, except for very short extensions, are made by employees of the Rural and Towns Division of the main office. This procedure is to prevent a large part of the agricultural engineers' time being devoted to proposed extensions and to enable them to devote a major part of their time to the development of the value of electric service to existing rural customers. Too, the development of proposed extensions can be conducted better by men who are especially qualified and trained for that type of work.

Extension of Rural Lines in 1932

In spite of the fact that agricultural conditions in Alabama have been generally depressed since 1928, and particularly so since 1930, the company constructed 46 new rural lines in 1932, consisting of a total of 48.3 miles to serve 132 new rural customers. These lines were all constructed at the urgent request of the people and after careful surveys of existing conditions and the proposed uses of electricity indicated that electric service would be to the economical advantage of the customers to be served. The new lines were constructed in 30 different counties, indicating that the value of rural electric service is being generally accepted as of economic advantage to agriculture even during a period of general business depression.

In addition to the 46 new lines, the company added 94 short extensions consisting of a total of 7.0 miles of lines to its existing rural lines in 1932. These extensions were added to serve 96 new rural customers who had observed the advantages of electric service to their rural neighbors and requested that the service be extended to serve them.

During 1932 the company made 82 surveys, in 52 counties, consisting of 1712 miles of lines to serve 3171 prospective customers. These surveys were made by employees of the company's main office, and all were made at the request of the people for electric service. In addition to these surveys made by the main office, the divisional agricultural engineers made surveys of 231 short extensions of service, and rechecked 140 former surveys of other short extensions at the instance of a repeated request for service by the people. At each request for service the company makes an analysis of the situation and explains the result of the analysis to the people. This analysis points out to the people the conditions under which the service would be economical to the customers to be served, and the company renders every possible assistance in promoting the development of such conditions that will make electric service feasible and economical.

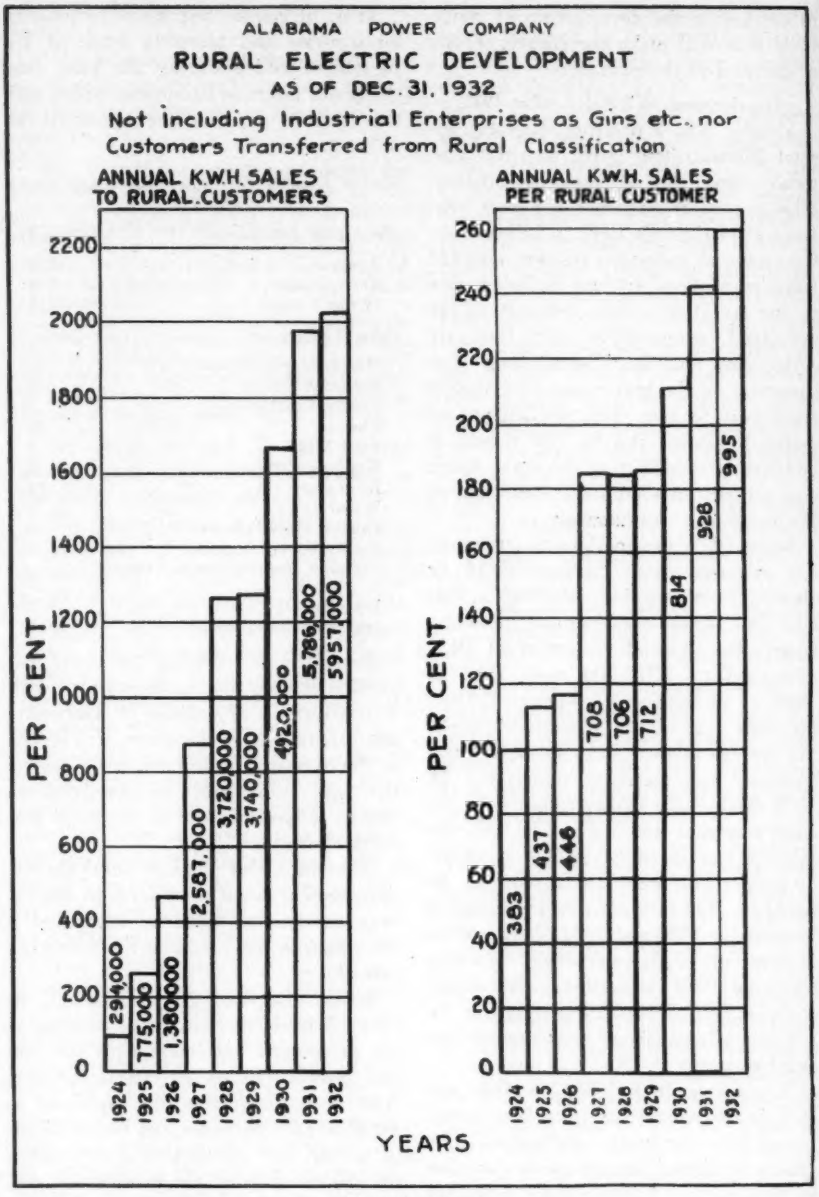


Exhibit No. 4

The number of requests for service by rural people is conclusive evidence that the rural people are anxious for electric service, and their effort with the cooperation of the company will make possible many of the extensions in the future. The company has a responsibility in providing service to new rural customers in that its employees have a more comprehensive idea as to whether the service will be economical to the customers than the customers can possibly have. Unless the company meets this responsibility, it will extend rural lines to serve customers under conditions that the service will become a burden to the customers and result in an unsatisfactory rural line. Therefore, before building the lines, we attempt to help the customers

in promoting the development of conditions that will make the electric service economical to the customers.

Development of Rural Load in 1932

Exhibit No. 4 presents the total annual kilowatt-hour sales to rural customers and the annual kilowatt-hour sales per rural customer for each year from 1924 through 1932. The kilowatt-hour sales to industrial customers served from rural lines are not included, due to the fact that a large percent of the industrial customers on rural lines are cotton-gins and the kilowatt-hour consumption by the gins varies very widely from year to year with the amount of cotton produced, and for that reason, if included, would distort the total figure and prevent an accurate presentation of the rural-load development.

Since 1929, the total rural customers has increased from 5322 to 5814 or about 9.3 per cent, but, as shown in Exhibit No. 4, the total annual kilowatt-hour sales to rural customers in 1932 amounted to 2,217,000 more than in 1929, or an increase of 59 per cent. During each year of the general depression the average kilowatt-hour sales per rural customer has increased materially. In 1929 the average kilowatt-hour sales per rural customer was 712 and in 1932 the average had increased to 995 kilowatt-hours per customer, an increase of 40 per cent. And even after making marked increases in 1930 and 1931, there was an increase of 67 kilowatt-hours per customer in 1932 over 1931. This represents an increase of 7.25 per cent in the average kilowatt-hour consumption per rural customer in 1932.

The figures in Exhibit No. 4 do not include customers that have been transferred from the rural classification. The reason for there being no greater increase in the average kilowatt-hour sales per rural customer from 1927 through 1929 is that during that period new rural customers were being added at a very rapid rate and naturally new customers make less use of the service than after becoming more familiar with its different uses.

During the year of 1932, the gross business added to rural lines, including new customers, was as follows:

	Connected Load in Kilowatts	*Estimated Annual Kwhr. Sales*
Existing Rural Lines	1,130.9	834,821
New Rural Lines (Constructed in 1932)	143.3	113,740
Total	1,274.2	948,561
Average Gross Increase per Rural Customer	220 Watts	162

It is, of course, impossible to present an accurate and complete detail of all equipment added during the year, but the major pieces of equipment added and the number of each are presented as follows:

MAJOR EQUIPMENT ADDED TO RURAL LINES IN 1932

Household Equipment	*Number*
Ranges	139
Refrigerators	104
Water Pumps	171
Farm Equipment	
Dairy Refrigerators	20
Bottle Washers	6
Cream Separators	3
Churns	15
Feed Mills	4
Ensilage Cutters	2
Incubators	16
Wood Saws	1
Hotbed Installations	6
Poultry-house Lighting	59
Lighting Installations to Control Insects	1
Brooders	26
Irrigation Installations	4

Especially in view of the rapid expansion of lines into rural territory with a relatively low density of customers and generally over the entire area served by the company, it has been very essential that the rural load be developed as rapidly as possible and in the most economical manner.

Therefore, this phase of rural electric development has of necessity been studied very closely, and based on these studies the company has practised the following procedure:

Before the lines are constructed, an effort is made to thoroughly familiarize the prospective customers with the uses and possible values of electric service. The rates for service are explained in detail to each customer and the problems of wiring, and installation of equipment are discussed with the prospective customers collectively and individually. This procedure is followed to prevent misunderstandings and to promote an increased value of the service when it is established.

After the line is constructed and the people have become somewhat accustomed to using electricity, we begin an effort to develop the load by contact with the individual customers and by going over their operations with them to point out the most profitable ways that each one can utilize the service. We, of course, soon learn which of the customers on each line are in the most favorable position to obtain increased values from the service, and centralize our activities with these customers. In this way we get installations made that serve as good demonstrations to the neighbors and thereby stimulate the value of electric service to all of the customers. We have not practised the donation of equipment nor the making of concessions in prices of equipment to rural customers for demonstration purposes, in view of the fact that when a piece of equipment is placed on the farm without cost or at a reduced cost to the farmer, it has lost a large part of its demonstrative effect in that the farmer feels that he has been granted a concession and is often rather extravagant in his praise of it. The neighbors, of course, know the conditions under which the equipment was installed and, therefore, often overdiscount the farmer's statements as to its operation. Too, the neighbors often feel offended at the fact that they cannot get the same terms and consideration granted the one farmer and thereby a barrier is created that sometimes retards rather than promotes good installations. But where the customer buys his own equipment at regular price and is not granted any concession, the demonstration is much more valuable; and, while this plan requires more effort to get the initial installation made, its value as a demonstration is much greater and more immediately effective.

The personal contact work is supplemented with occasional meetings to keep the people generally reminded that their electric service can be made more valuable to them and to stimulate their interest in obtaining the maximum value at the lowest possible cost. During the last three years we held a total of 165 such meetings in rural communities, that were attended by a total of 20,935 rural people.

In addition to the personal contact work and the rural meetings, we have distributed specially-prepared bulletins to rural customers as a part of the effort to familiarize them with the uses of electric service.

In 1925 the company cooperated with the Alabama Farm Bureau and the State Agricultural Experiment Station in the preparation of a bulletin, "Progress of Rural Electric Service in Alabama," that was generally distributed to agriculturists and farmers of the State.

In 1926 the company, in cooperation with agricultural agencies of the State and the National Committee on the Relation of Electricity to Agriculture, held a rural electric conference that was attended by agriculturists and farmers from each of the Southern States. At that time a booklet designed to stimulate

interest in the problems of rural electrification was prepared.

In 1928 the company prepared a bulletin, "Electricity Serves the Farm," which was distributed to all rural customers, to agricultural workers of the State, to bankers, and to others interested in agriculture, for the purpose of calling to their attention some of the uses of electric service on the farms of Alabama.

For three years the company distributed the monthly magazine, *Electricity on the Farm,* published by the Case-Shepperd-Mann Publishing Corporation, to a selected list of farm customers, and observed that this magazine is very effective as a rural-load builder.

The company advertises the uses of electric service on the farm page of the daily newspapers, with reference not only to equipment that the company's Merchandise Division sells but also to other uses of electricity that have been found to be most profitable to the farm.

Therefore, the company has attempted to carry on a continuous program of familiarizing the rural customers with the uses of electric service, with particular emphasis placed on uses of electricity that increase the farmer's net income. We have also attempted to keep our program adjusted with the progress of the customers' knowledge of electric service and to the condition of agriculture, and have borne in mind the necessity of conducting the program on the most economical basis possible.

Advancement of Agriculture Within the Territory Served by the Company Due to Uses of Electricity from Rural Lines in 1932

The rules governing the Thomas W. Martin Rural Electrification Award include the item "Agricultural Advancement within the company's territory due to uses of electricity." We interpret this to include only the uses of electricity by agriculture and by agricultural industries served from rural lines, or, in other words, the advancement of agriculture resulting from rural electrification. This company serves many farms and agricultural industries throughout the territory in the towns and cities served by it, but these services are not a result of rural electrification and for that reason are not included in the presentation. We are presenting the advancement of agriculture due to all uses of electricity from rural lines in 1932 and due to those uses of electricity added to rural lines in 1932, that the progress for 1932 as well as the total advancement may be seen.

The advancement of agriculture due to uses of electricity from rural lines is divided into three major phases or divisions:

(1) A more attractive, comfortable and convenient rural life resulting from the conveniences of electric lights and the use of the many labor-saving electrical appliances.

(2) The increased farm net income, resulting from the reduction of operating expenses or increasing the income by the uses of electricity.

(3) The use of electric service for the operation of rural community enterprises that provide additional conveniences to the people, stimulate the development of adjacent territory, and serve as an additional source of income to the local community.

We shall attempt to present the advancement with reference to each of the above items separately.

The advancement of agriculture, due to the uses of electric service in the homes, is an intangible item, the full value of which cannot be computed, explained or estimated, but can be appreciated only by those who have experienced life on the farm with and without these conveniences. We recognize and experience that the farmer is prompted in his desire for electric service primarily by the convenience of an electric-lighting system in his home. And electric lights, together with the uses of labor-saving appliances in the home, are and will no doubt continue to be the major value of rural electric service.

At the end of 1932 the company was serving 5814 customers from its rural lines, of which 86 were rural-industrial enterprises and 5728 were farms, rural homes, country stores, churches, etc. Approximately 5500 of these included service to a home. And, while it is, of course, impossible to present accurately the total reduction of labor to the uses of electricity in these homes, we are presenting an estimated amount of labor saved by some of those major appliances that are contributing to a reduced amount of drudgery in rural home making. (See table below.)

In addition to the estimated hours of labor replaced by electrical appliances in 5500 rural homes, there is also a marked reduction in the amount of labor and drudgery during the performance of the operations listed, and others, with electrical equipment. For example, the electric iron not only reduces the amount of time required to do the family ironing but also makes the operation easier during the procedure.

There are many other appliances that make home-making jobs much easier even though there may not be any actual saving of time in the operation. Some of such applications of electric service and the approximate number being used in the rural homes served by this company are:

Appliance	*Approximate Number in Use*
Vacuum Cleaners	185
Percolators	325
Waffle Irons	165
Toasters	220
Sewing Machines	85
Grills	65

Other electrical appliances in the rural homes add greatly to the convenience, comfort and pleasure of the home. Some of these and the approximate number of each being used in the rural homes are:

Appliance	*Approximate Number in Use*
Radios	700
Space Heaters	125
Fans	800
Water Heaters	63

Household Refrigerators

In addition to the above lists of electrical appliances and others that are reducing the labor and drudgery and making the rural home more attractive, comfortable and convenient, there are being used 645 electrically-operated refrigerators in the rural homes that are making the home more convenient, reducing the cost of living and making possible an increased income on the farm from the sale of perishable products. And even more important is the fact

APPROXIMATE NUMBER OF DIFFERENT APPLICATIONS OF ELECTRICITY IN RURAL HOMES AND THE ESTIMATED AMOUNT OF LABOR SAVED

Application of Electricity	*Approximate Number in Use*	*Estimated Labor Saved Per Unit*	*Total Estimated Hours of Labor Saved per Year*
Lights	5,500	1 hr. per week	285,000 hr.
Irons	4,400	½ " " "	114,400 "
Churns	200	½ " " day	36,400 "
Water Pumps	880	½ " " "	160,600 "
Ranges	825	250 " " year	206,250 "
Washing Machines	150	1 " " week	7,800 "
Total			810,450 hr.
Average per rural home			146 "

that refrigerators are resulting in the possibility of a better balanced and more palatable diet for the growing children in these homes.

There is probably no other single use of electric service that enters more completely into all phases of Southern agriculture than does the refrigerator. We all know that milk, butter, fruits and vegetables can be produced in abundance on the Southern farm and that a certain amount of these products is essential in balancing the diet, especially for growing children. But in spite of the fact that they are produced on the farm, they are not used on the farmer's table nearly to the extent that they are in town. The reason for this is, of course, that warm milk is not at all palatable and soon becomes unfit for human consumption. Fresh fruits and vegetables are seasonal on the farm, and without some method of storage they are used only during the season they are in production. Therefore, without refrigeration the farmer's family eats more meat, eggs and bread, which are the higher-priced foods, and less, milk, vegetables, and fruits, that are not only relatively cheaper but also essential to human health and to the normal growth of children.

Many of the 645 homes on rural lines, with electric refrigerators, are using the refrigerators not only for convenience and better foods for their own families, but are also storing surplus milk, butter, eggs, etc., until it is convenient to deliver them to a nearby market, and are thereby utilizing an otherwise waste product to increase the farm income.

If the 645 rural homes with electrical refrigerators had obtained the same refrigeration by the use of ice, which would have been possible only at a great inconvenience, it would have probably required an average of 30 pounds of ice per day per home, or a total of 10,950 pounds of ice per home per year. The price of ice to the rural home will probably average 50c. per hundred pounds; and based on that cost and consumption, the cost of the refrigeration would have cost them approximately $35,314 per year, whereas the cost of electricity for operating the 645 electric refrigerators amounts to only about $19,995 per year, resulting in a more convenient and better refrigeration at a saving of approximately $15,319 per year or about 10 per cent on the customers' investment in the refrigerators. However, the advancement of agriculture due to the use of the 645 refrigerators is not limited to the saving in the cost of refrigeration, in view of the fact that a majority of these homes were formerly without refrigeration from a practical viewpoint.

The value of electrical appliances in the rural home and the appreciation of the conveniences resulting from their use by rural customers are probably best indicated by the fact that during the year of 1932 there were added to the rural lines 139 ranges, 104 domestic refrigerators, 171 water pumps and other appliances in proportion. With the present farm income in Alabama, these appliances would certainly not have been added if they were not extremely valuable and highly appreciated by the rural customers.

The value of electric service for operations on the farm can generally be determined in dollars and cents, either in reduced cost of operations or in the resulting increased income from more or better products. To determine this value accurately it would be necessary to analyze each installation separately, but a rather close estimate can be made by taking the number of installations and the amount of work done and computing the value based on general conditions.

We are listing the major uses of electric service on farms served by rural lines with the estimated value of each to the farm.

The above table is not intended as an effort to present the complete value of electric service as used for farm operations, but to point out some of the specific and major items in which electric service is contributing to more efficient agricultural practices. The table also indicates that electric service is contributing to the promotion of a more diversified agriculture, which is recognized as essential to future agricultural prosperity of the State. This value of electric service to the advancement of agriculture is, of course, even more important than the immediate reduction of operating costs and increased income.

Rural electric lines are making available a convenient and cheap source of light, heat, and power for the operation of agricultural community enterprises, which are important and influential factors in agricultural development and affect areas even beyond the extent of the rural lines. It is, of course, impossible to appraise completely the value of such enterprises, but we are presenting a list of those served by the rural lines and attempting to point out some of the advantages resulting from their operation.

The use of electric service by each of the rural community enterprises enables the farmers and other rural customers along the rural line to get electric service at a cheaper rate than would be otherwise possible; therefore, there is an immediate advantage to those using electric service from the rural lines.

Each of the enterprises serves a useful function in the community and is important to the advancement of agriculture in the community.

RURAL COMMUNITY ENTERPRISES SERVED BY RURAL LINES

Type of Industry	*Total Number*	*Added in 1932 Number*
Cotton Gins	63	—
Grist Mills	10	1
Milk-Cooling Stations	3	—
Hatcheries	19	3
Woodshops	14	6
Airway Landing Fields	5	3
Airway Beacons	10	5
Airway Radio Stations	1	1
Trailer Factories	1	1
State Prison Farms	2	—
Concrete Products Plants	1	1
Gravel Pits	3	1

SOME USES OF ELECTRIC SERVICE ON FARMS SERVED BY RURAL LINES AND THE ESTIMATED NET VALUE TO THE FARMS

Application	*Total Number*	*Total *Estimated Annual Net Value*	*Added in 1932 Number*	*Added in 1932 *Estimated Annual Net Value*
Dairy Refrigerators	114	$ 63,928	20	$14,454
Bottle Washers	49	5,067	6	425
Churns	82	4,986	15	895
Feed Mills	12	2,400	4	800
Incubators	46	13,800	8	2,400
Milking Machines	21	9,500	5	2,200
Hotbed Installations	8	1,200	5	750
Poultry-House Lighting	152	27,540	59	2,196
Insect-Control Lights	7	3,500	1	500
Irrigation	9	11,100	4	4,200
Total	500	$143,021	127	$28,890

*The estimated annual net value is based on either the reduction in operating costs or the increased sale of farm products less the cost of operating the electrical equipment, including not only the cost of electricity but also the estimated fixed charges on equipment installed.

For example, the three milk-cooling stations, located on rural lines in the Black-Belt area of the State, cooled approximately two and one-half million gallons of milk, in 1932, that was distributed to the markets after being cooled. Without these plants the production of milk on the farms would be much more expensive and practically impossible except on the large dairy farm with individual cooling and storage systems. These plants really mark the beginning of general production of milk products on the farms of this area that are well adapted to dairy development with relation to soil and climate. The same is true of each type of community enterprise, and to present the accomplishment of each would be, to a large degree, a repetition of thought, using the different figures applicable in each instance.

In addition to the above-described values of rural electric service in the advancement of agriculture, the 1914 miles of rural lines along the highways and roads of the State result in an increased value of the abutting property. Just as an improved highway makes the adjacent farms more attractive, so does the presence of a rural electric line with the availability of electric service increase the sales value as well as the actual value of the adjacent farm property.

The conveniences of electric service along the highway eliminate the desire of the successful farmer to move to some town in order to provide his family with a more convenient and attractive home, and result in more of the successful farmers continuing to live on their farms with renewed interest and effort to develop a comfortable and prosperous farm.

Therefore, this intangible value of rural electric service is one of its major values, and one that continues to be appreciated more in farm communities with electric service.

Cooperation With Other Agencies

Rural electrification is primarily an agricultural-development program, and its maximum success is to be obtained through the full cooperation of the power companies that provide the service, the manufacturers that make electrically-operated equipment for operation in the home and on the farm, agricultural agencies that are engaged in the promotion of agricultural progress, and the farmers who in the end determine the value of the service to agriculture.

Therefore, this company has attempted to conduct its rural electric program with the full cooperation of each agency that has an interest in its full development, and throughout the entire effort has obtained splendid cooperation from each group that has contributed greatly to its progress.

The work was originated as a cooperative experiment with the Alabama Polytechnic Institute, and the results of this work—together with results from other similar work throughout the country—have been used as guiding information for the entire program.

We have attempted to keep State agricultural extension workers informed of the activities as being planned and conducted, and sought their counsel and advice both as to general principles and details of conducting the work. The cooperation of both county agricultural agents and home demonstration agents has been and continues to be very valuable to the work. The agricultural engineers keep the county agents advised as to developments and seek their advice on particular problems. But realizing that these agencies have many activities to keep them busy, we attempt not to interfere with their other activities. The company's agricultural engineers attempt to cooperate generally in other agricultural activities when such cooperation is of value to the effort. Realizing that accomplishment necessitates pursuing the task at hand, the agricultural engineers of the company do not attempt to become general agricultural agents, but confine their activities to problems related to rural electrification except in general cooperation with other agencies.

The vocational agricultural teachers are generally interested in the rural electric development and their cooperation has been very valuable on many of the rural lines. In 1932, the company conducted 14 meetings in cooperation with these teachers, and worked with them on many individual projects.

The rural electric development was originated in cooperation with the Alabama Farm Bureau Federation that had a committee of its farm members to assist and advise with reference to the work, especially during its preliminary experimental stages. Since the completion of the experimental work, the officials and field representatives of the Farm Bureau are consulted with reference to the progress of the work, and their cooperation has been valuable in this respect.

The company has always cooperated with the National Committee on the Relation of Electricity to Agriculture, Alabama being one of the first States to organize a project under that Committee's supervision. This cooperation has been very valuable to the development conducted by the company. During 1932 we had two visits from Dr. E. A. White, Director of that Committee, and realized much benefit from the continued cooperation.

The company has continuously taken an active interest in the rural activities of the National Electric Light Association.

Mr. H. M. Weathers, Manager of the company's Rural and Towns Division, served as Chairman of the Rural Service Committee in 1931-1932, and was Chairman of the Rural Sales Bureau.

Mr. E. C. Easter, the company's Chief Agricultural Engineer, assisted in the organization of a Rural Service Committee of the Southeastern Division in 1930, and served as its Chairman since its organization.

The company maintains an affiliation with the Association of Southern Agricultural Workers, and takes an active interest in its programs and accomplishments.

The agricultural engineers of the company are members of the American Society of Agricultural Engineers, and cooperate with the Society in its activities. Mr. Easter has served on several committees of the Society, was chairman of the Southern Section in 1931-32, and is now a member of the Farm Refrigeration Committee of the Society.

The agricultural engineers of the company cooperate with local dealers and manufacturers in getting equipment installed on the farm and in testing equipment that promises to be of value to the rural customer. In 1932, we cooperated with manufacturers in testing dairy sterilizers, sun lamps for growing chicks, and electrical equipment for heating soil.

Therefore, we are extending to and obtaining cooperation from each of the groups interested in rural electrification.

Erratum

The place of residence of Mr. A. W. Conover, author of "The Utilities Problem" appearing in the December issue of the Edison Electric Institute Bulletin, was erroneously given as Barstow, Okla. Mr. Conover is Vice-President and General Manager of the Oklahoma Utilities Company at Bristow, Okla.

RECENT PUBLICATIONS

A number of reports, prepared by committees of the National Electric Light Association prior to their dissolution, were transferred to the Edison Electric Institute by the Liquidating Committee of the N.E.L.A. Because of the value to the industry of the material contained in the reports they have been published by the Institute and may be purchased at the following prices:

Pub. No.	*Foreign Systems Coordination Committee*	*Price to Members*	*Price to Non-Members*	*Price to Foreign Countries*
A13	Power System Wave Shape	$0.20	$0.50	$0.60
	Hydraulic Power Committee			
A18	Economic Design of Hydro-Electric Plants	.20	.50	.60
A19	Hydraulic Governors	.20	.50	.60
	Power Systems Engineering Committee			
A16	Load and Revenue Forecasting	.30	.75	.85
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McGraw Prize Paper

OVERCOMING DANGER FROM TRANSFORMER AND OIL CIRCUIT BREAKER FIRES

Practices Established from Tests—Training of Personnel

By G. S. DIEHL and W. T. CROOK, Jr.

This paper won the 1933 Second McGraw Prize. Mr. Diehl is assistant to Superintendent of Operation, Pennsylvania Water & Power Company, Baltimore, Md., and Mr. Crook is Testing Engineer, Safe Harbor Water Power Corporation, Safe Harbor, Pa.

Every oil filled transformer and oil circuit breaker is a potential fire hazard. Though normally inert and harmless in appearance, if one of these pieces of equipment catches on fire it will interrupt service to customers, which means loss of revenue in addition to the direct damage and possibly other extensive losses.

Such fires have gotten beyond the control of station attendants and have practically destroyed the station itself. Help from outside is usually late in arriving on the scene, and even then is not apt to be familiar with the electrical hazards. The writer has witnessed the destruction of a station where the attendants did not have equipment available or previous training in fire fighting while the local fire department was practically helpless when it did arrive on the scene. In fighting any fire every minute of delay is serious as the fire quickly becomes increasingly harder to extinguish. For this reason the fire fighting equipment must be available and the men trained to use it.

The burning equipment should be completely isolated electrically at the earliest possible moment to prevent further destruction from the heat generated and to enable the men to fight the fire without fear of their own lives from electric shock. An interesting article appears in the October, 1930, *Quarterly of the National Fire Protection Association* entitled—"High Tension Wires and Hose Streams." Those interested in fighting fires near electric stations should read this article.

How can transformer and oil circuit breaker fires be extinguished in the quickest possible time?

The solution lies in the selection of the proper extinguisher and its effective application. This paper presents methods and procedures which have efficiently extinguished such fires. In any case the proper training of the station personnel is essential even though the particular installation suitable for one plant may not be applicable to another, because station design practices differ so widely. However, the fundamental principles of coping with fires are the same.

TRANSFORMER OIL FIRES

The earlier designs of transformers had an air space between the top of the oil and the cover. A fire in this type is liable to develop into a seething caldron if not quickly extinguished. Later transformer designs made use of the conservator tank and the gas filled principles. If a fire develops in a conservator type, the hot oil will boil over and spread fire over the ground, and so may carry the fire to adjacent equipment. In the event of trouble in a gas filled transformer, such as escaping gas, if fire ensues, it may be of the caldron type. By locating large transformers out of doors, this fire hazard to other station equipment is practically eliminated provided that the distance from the building is ample.

A series of tests covering the extinguishing of fires in oil filled apparatus was conducted by the Pennsylvania Water & Power Company and reported in the October, 1921, *Quarterly of the National Fire Protection Association.* The tank for these fire tests simulated a 10,000 kv-a., 70,000/11,000 volt, air space above oil type transformer. The oil was heated to about 200 deg. C., which was above the flash point, and then ignited. It was found that with an ample supply of air the oil burned freely, but if the supply of air was cut off the fire went out. Fires developed during the tests were extinguished in a few seconds by the application of a few gallons of soda acid liquid.

These tests were so successful that the company adopted a standard procedure at all stations for extinguishing internal transformer fires. This practice is still in effect in stations having the older type transformers. A 40 gallon soda acid chemical engine on wheels equipped with a curved pipe suitable for inserting into any opening in the transformer is available for immediate use.

This method was successful in extinguishing a fire in a 10,000 kv-a., 70,000/11,000 volt transformer on July 28, 1928. This fire originated from a short circuit on the internal connection board, and flames shot more than 20 ft. into the air. Several minutes later soda acid was injected into the transformer tank through one of these curved pipes and the fire was extinguished in a few seconds. Only about fifteen gallons of liquid were required. In subsequent tests of a similar type of fire, it was proved that CO_2 gas would have been equally effective.

The transformer core was removed for inspection by factory representatives. Repairs were made to the terminal board, loose copper particles were cleaned out, the core was washed with fresh oil and retanked. The oil from this transformer was filtered, then subjected to chemical analysis and found to be satisfactory for continued use. The transformer was returned to service and remained in service until it was replaced about six months later. The core remained under oil at all times during the fire. Had the drain valve been opened, and the oil level dropped, this transformer would have been permanently damaged. This point is important in coping with transformer fires. The fact that the station personnel had been trained in the handling of fire extinguishing equipment made possible the quick extinguishing of this fire. The training of personnel will be treated as a separate subject.

When contemplating making a large investment in an entirely different type and size of outdoor transformer equipment at the hydroelectric development of the Safe Harbor Water Power Corporation, an extensive study was again made to investigate the extinguishing of fires in this type of equipment. This

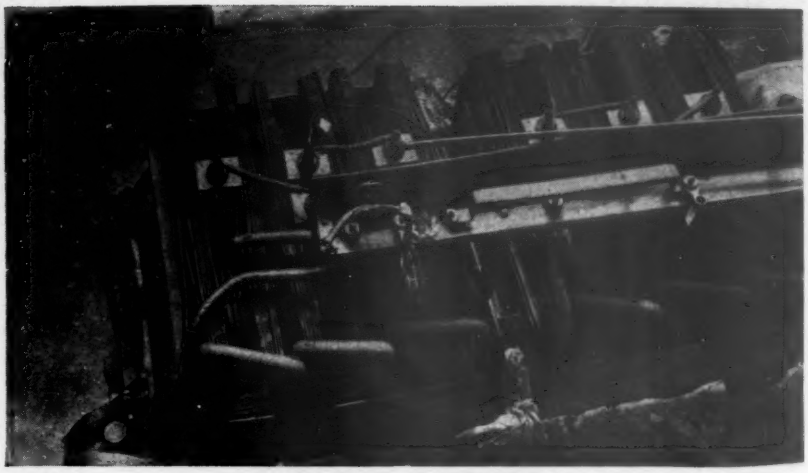


Fig. A—View of Transformer core when removed for inspection after fire.

installation consists of six (6) single phase 28,000/42,000 kv-a, 13,800/230,-000 volt, 60 cycles, O.I.S.C., forced air for higher rating, conservator type, nitrogen gas cushioned transformers, two (2) three phase, 30,000/45,000 kv-a, 13,800/66,000 Inert-aire Transformers, forced air for higher rating, and a number of station transformers located along the upstream wall of the power house. The transformer pockets are forty feet square with separating walls forty feet high. The floor is composed of a pit divided into three basins, each having a twelve-inch drain.

With the particular type of transformers installed at Safe Harbor it is probable that the fires would be:

a—Bushing Fire
b—Conservator Tank Fire
c—Ruptured Transformer Top Fire
d—Ruptured Tank Fire
e—Combination of any of the above fires

An investigation was made of the arrangements provided at other stations for extinguishing transformer fires of these types. From the information as obtained it was concluded that no entirely satisfactory method of coping with the above types of fires was available. A program of tests was laid out in order to find not only a suitable extinguisher, but also an effective method of fighting these fires. The latter part of this paper is devoted to the details of this series of tests which have not as yet been published.

As a result of these tests it was found that water was the most satisfactory and economical extinguisher for fires occurring in outdoor transformer equipment. The water, abundant and cheap, must be applied in ample quantity as a spray and provision so made that pools of oil will not accumulate in the pit.

For this installation water is supplied from the station service to a header located in the adjacent fire wall by means of a flexible hose and quick-connecting coupling. Risers from this header distribute the water to six carefully located nozzles which spray it over the top and sides of the transformer. The header connection is located in the side of the fire wall opposite the transformer in trouble. The attendant is provided with an extra hose to extinguish any ground fire.

During the tests a number of violent fires in the interior of the tank, on the top and sides, and on the ground were effectively extinguished in short order by means of this water spray method. In each of the fires the oil was heated to about 160°C, which is above the flash point, before ignition. The fire was permitted to burn from six to twenty minutes before the application of the water spray. The purpose of this procedure was to produce a condition that would simulate the violence of an actual transformer fire where the attendant could not get started immediately to extinguish it. The water and spray connections as installed at Safe Harbor can be readily made by one man unaided and then he is free to fight ground fires with the auxiliary hose, or to flood any portion of the cell not covered by spray. The installation of this equipment does not jeopardize any of the electrical connections to the transformer during their normal service. In the event that the fire is of an external type, the internal parts of the transformer are not affected. There has been no operating experience with this equipment except that gained during the testing program, but this was sufficiently satisfactory to justify the decision to adopt this method, which is quite different from the conventional ones for coping with transformer oil fires.

Although the fire extinguishing ability of liquids leaving a heavy residue that cannot be readily washed off is not questioned, they have the objection that, should they be injected into a transformer, it would be practically impossible to remove this residue from the oil ducts. Such liquids create an unnecessary mess, particularly around oil circuit breakers.

OIL CIRCUIT BREAKER FIRES

Oil circuit breaker fires may range from a fire in the top of a live pot breaker or larger dead pot tank to a spray of burning oil thrown many feet.

Fig. B—Extinguishing equipment used during practice tests.

From the series of tests previously referred to, and recorded in the October, 1921, *Quarterly of the N. F. P. A.*, a procedure was developed for fighting fires in the live pot type of oil circuit breaker equipment installed in the stations of the Pennsylvania Water & Power Company. This procedure consists of:

11 & 13 Kv. Circuit Breakers

1—Clear the switch affected by opening its disconnectors, and by any other switching which may be necessary. Do not clear the whole station unless all other means fail.
2—Extinguish burning oil on the floor by means of sand.
3—If the doors of the switch cells have not already been blown off, knock them off with a switch hook.
4—Extinguish the fire around the pots by means of sand. Be careful that no sand gets into the pots, as this will make the fire worse.
5—Extinguish the fire in the pots by a small amount of carbon tetrachloride.
6—Let the fire on the walls of the cell burn itself out.

During practice tests, the above-outlined procedure proved just as effective when fighting fires simulating those in other designs of breakers.

70 Kv. Oil Circuit Breakers

1—Clear all buses within reach of a stream of water directed into the burning switch cell. Do not clear the whole station.
2—Clear the switch affected by opening its disconnectors and by any other switching which may be necessary.
3—Throw off the door of the switch cell, if it has not already been blown off.
4—Extinguish the fire in the cell by use of soda extinguisher. Start at the bottom of the frame, working up the legs, around the pots, above the pots, then in the pots and finally along the walls and roof of the cell.

The effectiveness of the procedures outlined has been demonstrated many times, and in no case have there been failures.

Recent tests have shown that CO_2 gas is also effective in such fires.

When oil circuit breakers are installed in large open buildings, such as was common in older stations, it is difficult and expensive to provide a built-in, automatically controlled CO_2 gas system for fire protection. However, where breakers are installed in compartments, or rooms, such a system should be the quickest and most satisfactory method of extinguishing a fire.

At the Safe Harbor Plant, the 13.8 kv oil circuit breakers are grouped not more than five in a room. Each room is equipped with thermostats to release more than enough CO_2 gas to extinguish any fire occurring in that room. Releases actuated by the CO_2 pressure close all ventilating dampers. There has been no operating experience from this installation.

TRAINING OF PERSONNEL

The station attendant who understands the functioning of his equipment and the handling of fire extinguishing equipment possesses one of the most important features in effectively combating any type of fire. Too frequently attendants are unable to handle the equipment effectively, a feature which was demonstrated during the early tests to such an extent that a training program was inaugurated shortly thereafter. The training should include not only the instruction in proper operation of the fire extinguishing equipment, but also the proper application of the liquid.

The training program of the Pennsylvania Water & Power Company consists of annual practice tests during which the station attendants demonstrate their ability to apply any one of a number of extinguishers on different kinds of fires. Each shift man, or any of the men who are regularly around the stations is required to don a gas mask and equip himself with an extinguisher as though he were fighting a station fire. The fire which he fights is usually more severe than those actually experienced, so that the attendant gains confidence in his ability to cope with any burning station equipment. A supervisor, who is always on hand to show the operator how to improve his handling of the equipment, records the time required to extinguish the fires and thus arouses considerable interest and competition among the men. Occasionally during the practice tests new extinguishers and improved methods of application are demonstrated.

It is believed that the methods and procedures discussed will enable those who are interested to inaugurate or improve their protection against fires occurring in transformers and oil circuit breakers.

INVESTIGATION OF METHODS OF EXTINGUISHING OUTDOOR TRANSFORMER FIRES

This report is appended to the above paper in order to present the information and experience gained in determining the nature of adequate protection against fires in outdoor conservator type transformers. The object of the tests was primarily to determine not only the selection of a suitable extinguisher, but also the method of application, either by the use of the existing piping or by any other design found preferable.

With the particular type (outdoor conservator) of transformers installed at Safe Harbor it is probable that the fires would be of the following nature:

a—Bushing Fire
b—Conservator Tank Fire
c—Ruptured Transformer Top Fire
d—Ruptured Tank Fire
e—Combination of any of the above fires

The first step involved the erection of a three-sided test pocket, to simulate the Safe Harbor installation, along the tailrace of the Holtwood Hydro Station. This site was chosen because the flames would be clear of all buildings, transmission lines, and much of the auxiliary equipment, such as oil tanks, valves, etc., could be located on the upper track elevation. In addition, water and compressed air were available nearby for construction and test purposes. The test pocket consisted of 3/32" corrugated metal sheeting nailed to a frame work supported on poles forty-five (45) feet in height. Each side of the pocket measured forty (40) feet in width and height, with the open end facing upstream; the layout and dimensions duplicating the Safe Harbor Transformer pockets. (See Fig. 3.) An old 10,000 kv-a transformer tank provided with a false top of the same dimensions as the 230 kv-a units was supported on cinder-covered cribbing in the center of the pocket. The drawing (Figure 1a) shows a plan of the top elevation of the transformer and below this a cross section through the transformer at A-A. The oval dotted line in the top sketch represents the outline of the transformer tank; the second dotted line, the 3/8" steam coil lying approximately one inch under the oil, which was maintained at a depth of twelve inches above the water. The oil drips, shown at four places, have one-quarter-inch openings, which supply the "drip oil" mentioned later in the tests. A three-inch pipe line was used for filling the tank with water, while a one-inch line with a water meter connection was used to control the oil elevation during the test. Other equipment consisted of a glass sight gage to determine oil and water elevations, thermocouples for temperature readings of both oil and water, oil and water overflows, and oil supply lines.

The first problem in making a transformer fire is that of igniting a large quantity of oil. Preliminary experi-

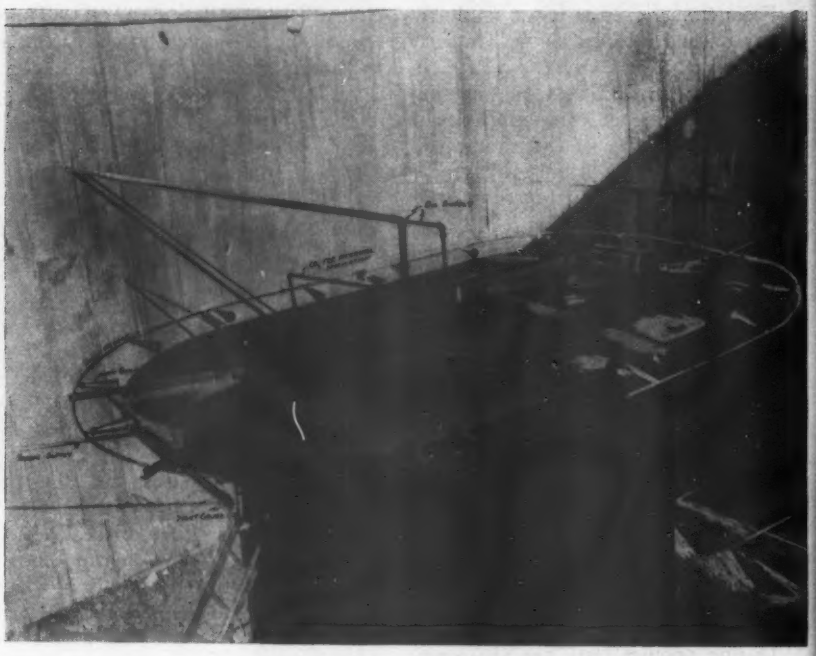
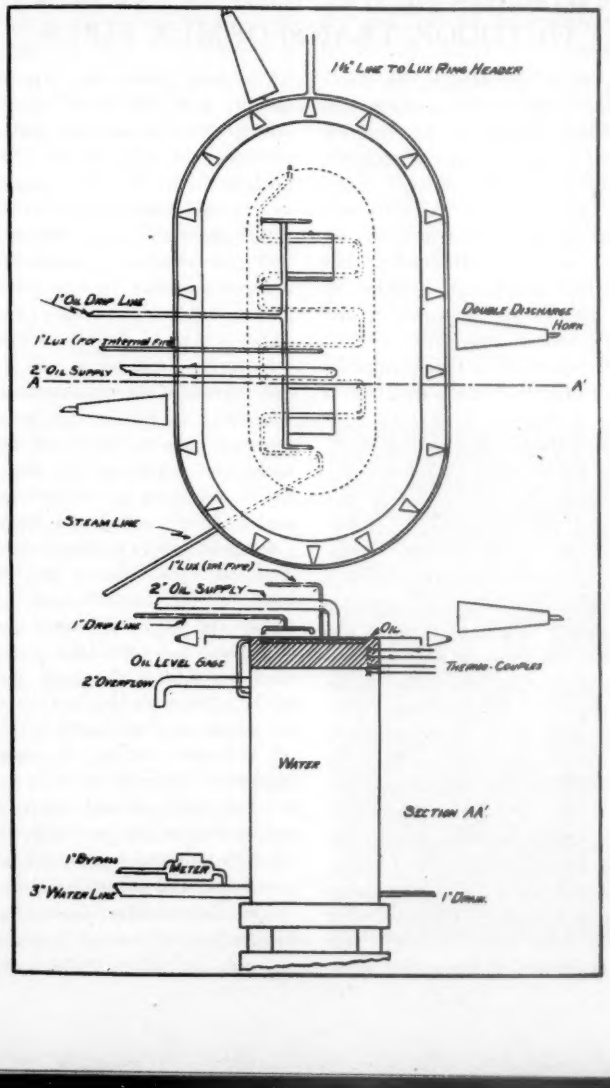


Fig. 1, Right—View of piping arrangement at transformer top. The dimensions of the false top are identical to the dimensions of the G. E. transformers at Safe Harbor. The oil drips supply oil to the top at positions occupied by the high and low tension bushings. Three horn system not shown on this picture.

Fig. 1a, Below—Drawing of top elevation of transformer.

ments were made on small fires from which a suitable method was evolved. A six-inch pipe, 34 inches long, was set in an upright position and filled with water to an elevation of 24 inches. To this was added six inches of transil oil with one-half pint of gasoline poured on top. The gasoline was ignited and the fire permitted to burn for two and one-half hours. It was found that only 2¼ inches of oil was consumed and the following temperature gradient existed in the oil and water:



	Depth		Temperature	
1	inch	in oil	370°F	185°C
2	inches	" "	300	150
3	"	" "	210	99
2¼	"	in water	180	80
3¼	"	" "	170	77
4¾	"	" "	140	60

It was evident that with the high temperature gradient existing in oil it was necessary to heat only the top layer to the high temperatures necessary for ignition. In the choice of a means for heating the oil in the tank, that of steam was found to be adequate, since the oil could be ignited somewhat below the flash point (140°C—fire point 160°C). The oil surface was maintained one inch above the steam coil and the temperature raised with steam supplied at 140 lb. per sq. in. gage pressure (temperature 183°C) by a dinkey engine boiler. Fires were started at temperatures varying from 120 to 160°C by a flaming oil-soaked rag which was ignited on the ground and then carried by a messenger wire to the transformer top and dropped through an opening.

After the oil had burned for a minimum of six minutes (max. twenty minutes), the flaming oil was then forced out of the top openings by an in-rush of water through the pipe connection near the bottom of the transformer. Meter readings showed that an average of 150 gallons of oil spilled per test was sufficient to insure a severe fire, not

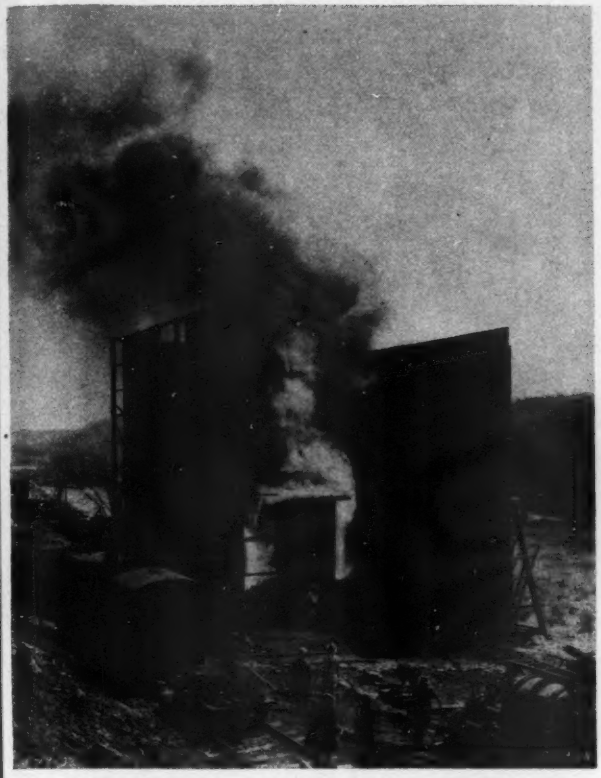


Fig. 2—View of general fire both top and ground. This fire was obtained by spilling over hot flaming oil and then adding oil through the drips. In general this was the type of fire obtained for the tests. The ground fire was most violent in the rear of the transformer, because of a slight tilt of the transformer top.

Fig. 3—View of a severe top and light ground fire. This fire was obtained by spilling oil and adding drip oil. When the oil was burning vigorously only the drip oil was supplied. As a result only a small amount of oil got to the ground before it was volatilized and burned. Picture taken before the Lux discharge in test No. 5.

only on the top and ground, but generally throughout the pocket.

EXTINGUISHERS AND METHODS OF APPLYING

In the selection of suitable extinguishers for test purposes consideration was given to features such as cleanliness, electrical conductivity, supply, first cost, maintenance, etc. It was decided that the following three extinguishers should be tried:

1—Carbon Dioxide Gas (Lux Equipment)
2—Water
3—A chemical mixture of Aluminum Sulphate, Bicarbonate of Soda and Water

Foamite was considered among other different types of extinguishers, but it was eliminated from the test program on account of the undesirable residue following its application.

Carbon Dioxide Gas

This gas was applied on test by special equipment furnished by The Walter Kidde Company, who was desirous of aiding in the investigation. The extinguisher is obtained in liquid form at pressures ranging from 700 to 800 pounds per sq. in. and will, upon being released to atmospheric pressure, expand to approximately two hundred and seventy times its original volume. The gas has a density one and one-half times that of air and its action is that of settling on and smothering a fire.

Two methods of fighting the test fires with the special Lux equipment were agreed upon:

a—The ring-header system which consisted of eighteen horns fitted with nozzles 3/32" in diameter and supported by a pipe ring around the outer edge of the transformer top.
b—The three-horn system which consisted of three double discharge horns placed on the same elevation as the transformer top and discharging across it.

It was agreed upon that the carbon dioxide gas could fight only the top fires, while a fire hose controlled the ground fire. All tests using gas were conducted in this way.

Water

The failure of water in numerous cases to effectively control large oil fires has created an adverse feeling toward its use on transformer fires. This feeling is somewhat biased, for water possesses certain desirable qualities which are often rendered of little value because of the methods used in applying it as an extinguisher. With suitable piping already provided at Safe Harbor and because of the large enclosed drains in the transformer foundations, it was believed advisable to experiment with water and devise a method that would be satisfactory for our particular needs.

The piping in each of the side walls of the transformer pocket consisted of three 1¼-inch pipes running upward from the bottom of the pocket with two outlets in each pipe at elevations above the transformer. Because of the hooked appearance of bent nozzles connected to these outlets the piping was given the name "J-tubes." The proper size and shape nozzle for use in both the upper and lower tiers was determined by experiment. An excellent view of the nozzles on the left wall is obtained on Fig. 7, while the spray from the two lower tiers is seen on Fig. 9.

In the preliminary tests (1-11), only the lower tier of nozzles on both sides were used, while in the remaining tests (12-17), both the upper and lower tiers on both sides were used. When using both sections, the nozzle angle was so adjusted that the discharge from the lower tier sprayed the sides of the trans-

Fig. 4—View of a violent ground fire and light top fire. No drip oil was added to the spilled oil in this fire. The intensity of the fire is controlled by the amount of oil spilled and by the degree to which it is spread on the ground. Large pieces of sheeting laid on the ground and heated by the flaming oil always made the ground fires more violent. Picture taken before application of Chemical Mixture No. 1 on test 15.

Fig. 5—View of Lux gas one-quarter minute after discharge of six 50# bottles. Note how the gas banks heavily on top and that the ground fire was controlled by a fire hose. Picture applies to test No. 14 in which a reflash occurred. See picture No. 6. Time of discharge 40 sec.

Fig. 6—View of Lux gas two minutes after beginning of discharge. The heavy gas cloud observed in Fig. 5 has diffused into the one seen above. These pictures were not taken from the same test but they both are representative of the action of the gas. The flames following the reflash may be plainly seen on the transformer top. In test No. 18 in which twelve 50# bottles were discharged this reflash did not occur.

Fig. 7—View of Lux gas issuing from openings after a discharge of two 50# cylinders directly into the transformer top. An excellent view of the twelve J-tubes on the left wall is obtained from this picture. The internal fire was extinguished in less than one minute.

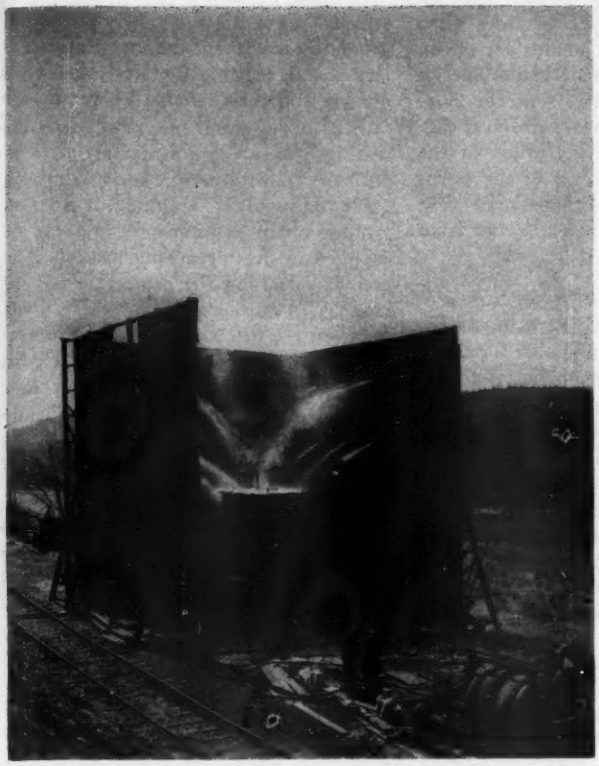


Fig. 8—View of discharge of chemical mixture No. 1 from J-tubes. Note how erratic the discharge appears. Pressure at Duomixer 45# per sq. in. Header pressure 27# per sq. in. Amount of powder discharge: 300# A. Sul. and 240# Bicarbonate of Soda. Top fire extinguished in three minutes.

Fig. 9—View of water discharge from lower set of J-tubes. Test No. 3. Header pressure 27# per sq. in. Discharge 175 gal. per minute. Fire extinguished in 4 min. and 30 sec. For fire before extinguisher was applied see Fig. 2.

former, while the upper tier discharged directly on the top (Fig. 8).

Chemical Mixture

The chemical mixture was applied to the fires in the same manner as water, i.e., through "J-tubes." The James M. Castle Company of Philadelphia cooperated by loaning a No. 120 Duomixer (originally designed for the application of foamite). This device combined aluminum sulphate and bicarbonate of soda in proportions of 50 pounds of sulphate to 45 pounds of bicarbonate. Water was applied at 60 pounds per sq. in. to the mixer, where it was divided and passed through two venturi orifices, the throats of which were open at the base of the chemical hoppers. After picking up the chemical, the velocity head of the water was partially returned to pressure head in the two hoses exhausting the mixer. These hoses, fifty feet in length, were joined to the "J-tube" header at ground elevation by a Siamese connection. The first chemical reaction takes place in this header and is accompanied by a slight increase in pressure. The probable chemical reaction is $Al_2(SO_4)_3 + 6\ NaHCO_3 = 2\ Al(OH)_3 + Na_2SO_4 + 6CO_2$. The CO_2 appears in the form of bubbles and foam which cover the surface with which they come in contact.

DISCUSSION OF RESULTS

Tests Nos. 5, 7, 8, 11, 14, 17 and 18 involved carbon dioxide gas. Inspection of the data shows that out of six tests with fire on both top and ground the gas succeeded in extinguishing the top fire four times. Out of these four tests one reflash occurred and is not charged as a failure, for it was observed that the oil reflash came from the smouldering torch inadvertently left on the transformer top. This reflash is seen in Fig. 6, which also shows the gas cloud two minutes after the beginning of discharge.

It was believed that increasing the gas discharge would remove the possibility of reflash. Accordingly, a severe fire was made (Test No. 18) and a discharge of six 50-pound bottles was followed in forty seconds by a similar discharge. The top fire was extinguished in less than one minute. The additional cooling effect of the extra gas evidently prevented a reflash.

Test No. 17 was made to determine the effectiveness of carbon dioxide gas on an internal fire. This type of fire was made by igniting the oil and then lowering the level six inches from the top. Since the air supply was limited, the fire was not severe. There is no doubt that carbon dioxide gas is ideal for this type of fire, for in this particular test the fire was extinguished and the temperature inside the top lowered to 11°C two minutes after the discharge began.

Water

Tests Nos. 1, 2, 3, 6, 8, 10, 12, 16 were conducted with water as the extinguisher. Test No. 1 was the only failure out of the series and it was the result of poorly shaped and located nozzles. Improvements in the design were made following this test so that the discharge from each nozzle was in the form of a spray and joined the discharge of the adjoining nozzles before reaching the transformer. An excellent view of this spray is obtained in Fig. 9. In spite of the fact that the early tests using water were purely of an experimental nature, the results were very satisfactory. In the later tests using water some of the

test fires were the most violent and severe of the entire program. The minimum time to quench a top fire with water was one minute; the maximum, four and one-half minutes. In every test the spray was sufficient to also quench the ground fire without the use of an auxiliary extinguisher. Beginning with Test No. 12, the time required to quench a fire was lowered by using both the upper and lower sets of "J-tubes." A discharge of 300 gallons per minute was obtained from twelve tubes with a header pressure of 27 pounds per sq. in. and 175 gallons per minute from the six lower tubes with the same header pressure.

Chemical Mixture

Results on four tests using the chemical mixture were particularly satisfactory. The effectiveness of the extinguisher was demonstrated in tests Nos. 4, 13 and 15, where the fires were unusually severe and difficult to control. It was observed that the reaction of the chemicals caused a rise in header pressure of three to seven pounds per sq. in. The effect was noticeable in the uneven and spurting discharge from the nozzles. A thin film of white chemical covered the transformer and walls of the pocket after the discharge of the extinguisher. This film was removed very easily by means of a water spray from a one-inch hose.

CONCLUSIONS

The first extinguisher, *Carbon Dioxide Gas,* was found suitable for internal fires in transformers, but not reliable in controlling violent external fires. The gas also requires the use of an auxiliary extinguisher to control ground fires. (The external fires herein referred to were in a three-sided enclosure, top open. We believe that had the fourth side been closed, the ground fire would have been extinguished if the proper quantity of CO_2 gas were available.)

The *Chemical Mixture* proved very effective in controlling severe top and ground fires without the use of an auxiliary extinguisher. It acts almost as quickly and is as reliable as water.

Water possessed the most desirable features for protection against fires in outdoor transformers. It is relatively quick, its supply is unlimited, it is clean, requires small maintenance, and can be supplied in flexible arrangements. The cost of installing the protection is very cheap. In consideration of these many features, the fire walls of the transformer pockets at the Safe Harbor Hydro Electric Development have been provided with equipment which it is firmly believed will effectively combat any fire in which the transformers may become involved.

Further plans are now under way to provide a test set-up similar to the one described in this report in order to also determine the nature of adequate protection against fires in conservator type indoor transformers.

TRANSFORMER FIRE PROTECTION TESTS

TEST NO.	DATE 1932	TEMP. °C. OIL	TEMP. °C. FLAME	NATURE OF FIRE	INTENSITY	EXTINGUISHER	& MIN. OF DISCH.	PIPING ARR'G'MT	AMOUNT USED	TIME TO QUENCH TOP	TIME TO QUENCH GR'D.	RESULTS
1	4-1	140	-	Spill over	Top: Vigor. Grd: Small	Water	8	6 lower J-Tubes	-	-	-	failure
2	4-13	153	640	Spill over & drip oil	Top: Severe Grd: "	"	11	"	-	-	4 Min.	success
3	4-14	159	658	Spill over	Top: Severe Grd: "	"	5	"	875 gal.	4 min.	5 min.	success
4	4-14	158	635	Spill over & Drip oil	Top: " Grd: "	Chem. Mix.	5	"	-	4 min.	4 min.	success
5	4-19	159	655	"	See Picture 3	(CO_2) Gas	1	ring header	300#	-	3 min.	failure
6	4-19	Oil burn. from #5		Spill over	See Picture 4	Water	3	6 lower J-Tubes	525 gal.	1.75 min.	2.75 min.	success
7	4-19	152	560	Spill over & Drip oil	Top: Light Grd: Severe	(CO_2) Gas	1.5	3 horn system	300#	-	-	failure
8	4-19	Oil burn. from #7		"	Top: Severe Grd: Severe	Water	4	6 lower J-Tubes	700 gal.	3.25 min.	4 min.	success
9	4-20	153	642	"	Top: Severe Grd: Light	(CO_2) Gas	1.3	ring header	300#	1 min reflash	-	failure
10	4-20	Oil burn. from #9		"	Top: Severe Grd: Severe	Water	6	6 lower J-Tubes	1050 ga.	3 min.	5 min.	success
11	4-20	153	660	Spill over	Top: Severe Grd: Light	(CO_2) Gas	.75	ring header	300#	1 min.	2 min.	success
12	4-27	159	595	Spill over & Drip oil	Top: Light Grd: Light	Water	4	12 J-Tubes	1750 ga.	3 min.	2 min.	success
13	4-27	148	630	"	"	Chem. Mix.	3.5	12 J-Tubes	-	3 min.	3 min.	success
14	4-28	142	640	Spill over	Top: Severe Grd: Severe	(CO_2) Gas	.75	ring header	300#	-	2 min.	failure
15	4-28	Oil burn. from #14		"	"	Chem. Mix.	4.5	12 J-Tubes	-	3 min.	4 min.	success
16	4-28	140	608	Spill over & Drip oil	"	Water	2.5	12 J-Tubes	750 gal.	1 min.	1.5 min.	success
17	4-28	120	254	Internal	Light	(CO_2) Gas	-	1 inch pipe	100#	1 min.	-	success
18	4-28	156	695	Spill over & Drip oil	See Picture 3	(CO_2) Gas	1.3	ring header	600#	1 min.	2.5 min.	success
19	4-28	151	410	"	"	Chem. Mix.	3	6 Upper J-Tubes	-	2 min.	7 min.	success

Summary of Transformer Fire Protection Tests

SHIELDING OF GROUND RETURN CIRCUITS

Comment on a report prepared by the Joint Subcommittee on Development and Research

Among the reports presented at the recent meeting of Division 2 of the Joint Subcommittee on Development and Research, was Technical Report 2K-2 entitled "Shielding of Ground Return Circuits at Low Frequencies." This is a companion report of Engineering Report No. 14, "Coupling Factors for Ground Return Circuits—General Consideration and Methods of Calculation," which is published in Volume 2 of the engineering reports of the Joint Subcommittee on Development and Research. Engineering Report No. 14 deals with the calculation of coupling in the absence of shielding, detailed discussion of the latter being reserved for this report.

The report on shielding is primarily intended to afford means for calculating the reduction, due to a variety of shielding circuits, in longitudinal voltages along telephone conductors due to ground return fault currents in power circuits. With some of the shielding arrangements discussed in this report, reductions of more than 90 per cent can be effected, while in a large proportion of field problems, smaller, though considerable, reductions may be brought about by the shielding action of power line ground wires, telephone or power cable sheaths, railway tracks, and water, gas or other types of pipe lines. Although the formulas and curves of this report are primarily for the calculation of shielding at 60 and 25 cycles, the general principles and methods are applicable to shielding problems at somewhat higher frequencies.

The first section of the report discusses the physical processes underlying shielding, with examples based on simple single conductor circuits, illustrating the effect of separately varying each of the factors entering into the calculations of shielding. For instance, it is shown that for a shielding conductor to be effective it is necessary that its radial distance from either the disturbing or disturbed conductor be small. If the shielding conductor is located near the disturbed circuit the current induced in it will be smaller than if located near the disturbing circuit, but at the same time its coupling with the disturbed circuit will be large, and therefore the small currents will be more effective in reducing the voltage due to the primary circuit. It is also pointed out that although the shielding is influenced by the earth resistivity this effect is ordinarily not important as compared to the variation of the other factors. At low frequencies, in the order of 25 and 60 cycles, attainment of substantial shielding requires that the resistance of the shielding circuit, including both the conductor and ground connections be very small. At higher frequencies larger values of resistance can be tolerated in the shielding circuit.

The second section of the report deals with the extension of formulas applicable to the simple single conductor circuits to the type of problems met with in practice. For instance, methods are given for calculating the shielding for multi-conductor circuits, such as a three-phrase power circuit with two ground wires. In most cases, multi-conductor circuits can be replaced by equivalent single conductor circuits by use of geometric-mean radii and distances. Methods of calculation are also given for shielding circuits with multiple grounds, where the current in the shielding circuit is not uniform throughout its length. Still another condition considered is that of a shielding conductor located on a telephone line and grounded at points beyond the ends of the exposure so that a large part of the shielding action takes place beyond the limits of the exposure. Methods are also given for calculating shielding where the impedances involved are not constants but are functions of the current density in the shielding conductor. An example of such a case is a lead-sheath cable with iron armoring.

The last section of the report is in the nature of a handbook giving necessary constants and formulas for calculating the shielding produced by various shielding circuits met with in practice. One of the important features in this section is a group of curves and charts which greatly simplify the calculation of shielding for the range of conditions most commonly experienced. In this section are considered such subjects as shielding from ground or shield wires on aerial power and telephone lines; the shielding from grounded cable sheaths, aerial and underground, both power and telephone; the shielding from iron armored lead sheath cable; and the shielding from other communication conductors on the same line or within the same cable. Some consideration is also given to the shielding from miscellaneous grounded conductors such as water and gas pipes, rails, etc.

The report has not yet been approved by the Joint Subcommittee but it is expected that final revisions will be made and necessary approval secured so that reports will be available within a month.

ELECTRIC WELDING STANDARDS

The first national standards in the field of electric welding were recently approved by the American Standards Association. These standards covering the electrical apparatus for arc and resistance welding are intended to assure an adequate and properly controlled supply of electric current to meet the exacting requirements of welding service. Generators, transformers, and other equipment are covered by these standards.

These standards were prepared by a Sectional Committee on Electric Welding Apparatus, organized in 1931 under the sponsorship of the American Institute of Electrical Engineers and the National Electrical Manufacturers' Association. The scope of the project under which these standards were prepared was as follows:

"The formation of standards for electrical welding apparatus, including definitions and terms, classifications, rating, heating, efficiency, testing methods, dielectric tests, standard value of current and voltage, and name plate data."

The Sectional Committee consisted of representatives of five producers, six consumers, and eight general interests. The standards as finally submitted by the Sectional Committee to the sponsors, and subsequently approved as American Standards, are in general accord with the original A.I.E.E. Standards, no radical changes having been made. A number of minor changes, however, were made in the definitions and in some of the technical requirements, the definitions having been revised to agree with those now generally accepted by the welding industry as proposed by the Sectional Committee on Definitions of Electrical Terms, and certain of the performance requirements were revised to bring them into accord with generally

accepted current practice. These standards are designated as follows:

Electric Arc Welding Apparatus	C 52.1, 1933
Resistance Welding Apparatus	C 52.2, 1933

It is expected that these standards will be available by February 1, either from the American Institute of Electrical Engineers, 33 West 39th Street, or American Standards Association, 29 West 39th Street, New York City.

POWER COMPANIES INVITED TO COMPETE FOR COFFIN AWARD

The Prize Awards Committee of the Edison Electric Institute, through its Chairman, Frank W. Smith, has invited all electric light and power companies operating in the United States to compete for the Charles A. Coffin Medal, which, with the exception of 1932 and 1933 when no awards were made, has been presented annually since 1923 for distinguished contributions to the development of the industry.

Under the terms of the Charles A. Coffin Foundation as established by the General Electric Company the Charles A. Coffin Award will be made to that company which during the year 1933 has made a distinguished contribution to the development of electric light and power for the convenience of the public and the benefit of the industry.

Presentations of accomplishments by companies desiring to compete for the award are to be made not later than April 1st, 1934. The presentation of the award will be made at the 1934 Convention of the Institute, to be held at Atlantic City, June 4-7. In addition to the Charles A. Coffin Medal, the award carries with it a gift of one thousand dollars for the employees' benefit fund of the winning company.

Mr. Smith, in extending the invitation, wrote: "Aside from the distinction and honor of winning this coveted award, the companies which have entered former contests have found the efforts put forth in the study, investigation and review incident to the presentation of its accomplishments to be of benefit to their organizations.

"Especial attention is called to the statement in this invitation that elaborate and costly reports or exhibits are unnecessary, in fact, the committee urges simplicity of make-up. A clear presentation of essential facts is the principal thing desired.

"The exhibits of companies which have striven in the past for the award, which was formerly administered by the National Electric Light Association, are on file at the Edison Electric Institute office in New York City and are available for inspection."

Charles A. Coffin Medal Awards have been made in the past to:

Southern California Edison Company for 1922
Public Service Company of Northern Illinois for 1923
Consumers Power Company for 1924
Commonwealth Edison Company for 1925
Edison Electric Illuminating Company of Boston for 1926
Puget Sound Power and Light Company for 1927
El Paso Electric Company for 1928
Public Service Electric and Gas Company for 1929
Virginia Electric and Power Company for 1930

In addition to Mr. Smith, the Prize Awards Committee consists of George B. Cortelyou, President of the Edison Electric Institute, and Karl Taylor Compton, President of the Massachusetts Institute of Technology.

A.S.A. REPORT ON ROTATING SECTIONAL MACHINERY

The American Standards Association advises that the first report of the Sectional Committee on Rotating Electrical Machinery (C50), organized in 1930 under the auspices of the A.S.A. has been published and is now being circulated for the purpose of securing comments and suggestions. The report includes standards for direct-current rotating machines; synchronous generators, synchronous motors and synchronous machines in general; synchronous converters; induction motors and induction machines in general; and a-c and d-c fractional-horsepower motors.

The report is largely based upon the five standards of the A.I.E.E. on these same subjects. Since the proposed new standards are in the nature of a revision, they will, when approved, supersede these five standards. The scope of the standards has been broadened, however, to include, in addition to the material covered in the A.I.E.E. standards, a large number of widely used standard rules developed by N.E.M.A.

Up to the present time these A.I.E.E. and N.E.M.A. standards have served as the principal bases of specifications for electrical machines. It is expected that the combination of these two important sets of standards in a single publication, to be approved finally by the A.S.A., will be of maximum usefulness to the buyer, seller, and manufacturer of rotating electrical machinery.

In the proposed standards emphasis has been placed upon definitions of the terms and conditions which characterize the rating and behavior of electrical machinery, with special reference to the conditions upon which acceptance tests are based.

Comments and suggestions are solicited from all interested in order to assist the committee in satisfactorily rounding the standards into final form. All comments should be addressed to E. B. Paxton, General Electric Company, Schenectady, N. Y.

At the end of a six months period, after criticisms and comments have been received and considered, the standards will be submitted through the sponsor, the Electrical Standards Committee, to the American Standards Association for approval as American Standards.

Copies of the report may be purchased from the office of the American Standards Association, 29 W. 39th St., New York, N. Y., at 25 cents each.

J. F. Fogarty Elected President The North American Company

James F. Fogarty was elected president of The North American Company, at a meeting of the board of directors, on Jan. 4, to succeed Frank L. Dame, who died Dec. 30. Mr. Fogarty has been with the company 31 years, for about 11 years as vice-president, and he is also a director and a member of the executive committee.

As the new executive head of The North American Company, Mr. Fogarty made the following statement:

"The North American Company and the public utility industry have suffered a great loss in the death of Mr. Dame. The strong position of the company reflects basic executive policies carried on for many years under the direction of Mr. Dame and of Mr. Gruhl, who until his death a year ago was joint executive head with Mr. Dame. In the carrying on of these policies I was privileged to share through years of close association with both of them. The company's conservative practices and its relationship with its decentralized operating subsidiaries will continue without change."

FRANK L. DAME

Frank Libby Dame, Chairman of the Board and President of The North American Company and a Trustee of the Edison Electric Institute, died on Dec. 30th at his home, 79 Oxford Boulevard, Garden City, L. I. Mr. Dame had been slightly ill for the week preceding his death and the night before had suffered a stroke of apoplexy. He is survived by his wife, and three sons, Frank Elvidge, Edward Libby and Robert Orville Dame.

A descendant of early New England families Mr. Dame was born in Boston, on March 21, 1867, the son of Seth T. and Josephine R. (Libby) Dame.

After being graduated from the English High School, Boston, in 1885, he attended Massachusetts Institute of Technology and was graduated in 1889 with a Bachelor of Science degree in electrical engineering. His career, which embraced all activities of the public utility industry, including construction, development, operating, financing and management, closely paralleled that of the company he headed, although it was not until 1920 that Mr. Dame became associated with The North American Company.

Mr. Dame's first job after leaving college was in the testing room of the Westinghouse Electric Company, in Pittsburgh. His first construction assignment was in Newburgh, N. Y., and late in 1889 he was sent to Portland, Ore., as the company's local engineer. Within a year he was taking an active part in the management of public utility properties. Later he became general superintendent of the Vancouver (B. C.) Railway and Light Company, and in 1891 returned to Portland as engineer in the lighting department of the Northwest Thomson-Houston Company. For two years he also engaged in street railway construction and the replacement of equipment in various cities in Oregon and Washington.

In 1893 Mr. Dame became general manager of the Seattle Consolidated Street Railway and later general superintendent of the Tacoma Railway & Motor Company, taking part in the reorganization of several companies under the name of Tacoma Railways Company. He continued in charge of this property until 1901, when he was made general manager of the Union Electric Company, of Dubuque, Iowa. The General Electric Company in 1903 appointed him as engineer of its committee on local companies, supervising the operations of public utility companies in various parts of the United States then controlled by the General Electric Company, and his active management duties entailed traveling some 50,000 miles a year.

In 1909 he was made a vice-president of the Electric Bond and Share Company, severing his connection with that company in 1912, and later becoming president of Central States Electric Corporation. During the World War he served in the facilities division of the War Industries Board.

In 1920 he was named a vice-president of The North American Company and six months later, in 1921, was elected president. On April 25, 1932, he was elected Chairman of the Board of Directors of The North American Company, but he continued active service in a full-time capacity in the same corporation with the late Edwin Gruhl, his successor as president, and who was vice-president and general manager while Mr. Dame was president. When Mr. Gruhl died last January, Mr. Dame again was elected president, retaining the office of chairman of the board.

Mr. Dame also was Chairman of the Board of North American Edison Company, the principal subsidiary of The North American Company, since the organization of the former company in 1922. He was Chairman of the Board of the Cleveland Electric Illuminating Company and Wired Radio, Inc., President of Western Power Corporation and an officer or director of other public utility companies included in The North American group.

He also was a director of companies in which The North American Company has substantial interests, including the Detroit Edison Company, Pacific Gas and Electric Company and the North American Light and Power Company.

Honorary pall-bearers were Edwin M. Bulkley, John Foster Dulles, Charles A. Stone, Harrison Williams and Harley P. Wilson, who are among the directors of The North American Company; James B. Black, Frederick W. Doolittle, James F. Fogarty, Herbert C. Freeman, Clinton W. Hough, Frederick N. Piske and Robert Sealy, officers of The North American Company; Eben G. Crawford, President, The Cleveland Electric Illuminating Company, Cleveland; Louis H. Egan, President, Union Electric Light and Power Company, St. Louis; William F. Ham, President, Washington Railway and Electric Company, Washington; William McClellan, President, Potomac Electric Power Company, Washington; Sylvester B. Way, President, The Milwaukee Electric Railway and Light Company, Milwaukee; C. F. Richardson, President, West Kentucky Coal Company, Sturgis, Ky.; Alex Dow, President, The Detroit Edison Company, Detroit; A. F. Hockenbeamer, President, Pacific Gas & Electric Company, San Francisco; J. D. Mortimer, Vice-president, North American Light & Power Company, Chicago; John H. Hanna, President, Capital Transit Company, Washington, all of whom are executives of North American subsidiaries or of allied companies. Also Owen D. Young, Chairman, General Electric Company; Sidney Z. Mitchell, former Chairman, Electric Bond & Share Company; George O. Muhlfeld, President, Stone & Webster, Inc.; C. E. Groesbeck, Chairman, Electric Bond & Share Company; Floyd L. Carlisle, Chairman, Niagara Hudson Power Corporation; B. C. Cobb, Chairman, Commonwealth & Southern Corporation; P. B. Sawyer, Vice-president, Electric Bond & Share Company, all of New York; Fred Vogel, Jr., of Milwaukee, a director of the Milwaukee Electric Railway and Light Company, and W. H. Fillmore of Cincinnati, a director of the Cleveland Electric Illuminating Company.

INDUSTRIAL HEATING NEWS

Contributed by Industrial Power & Heating Committee, E.E.I.

FROST-PROOF VALVE CABINETS

A 300 watt heater placed inside a small cabinet built around a pipe line valve insures the perfect operation of this valve throughout the winter. Here is a job where electric heat has practically no competition.

LIVE STOCK WATERING TANK

A 60 foot length of soil heating equipment was dropped into a tank 10 ft by 3 ft by 2 ft and keeps the temperature of the water to at least 40° even on 10° days. Thus, 400 watt is doing an economical job with absolutely no attention required.

GLUING MACHINE

A continuous gluing machine where the paper stock is passed over a roller running in liquid glue requires that the glue be kept at a very definite temperature. An immersion unit with thermostatic control goes about this job with no fuss or attention. The elimination of fire hazard is also an important point in this application of heat.

CEMENT BLOCK MOLDS

In making molded cement blocks it has been found necessary to apply heat to the metal mold to keep it from removing particles from the block when it is removed from the mold. Strip heaters attached to the metal mold perform a perfect job, as well as allowing a thinner mix to be used, which insures a smoother surface finish on the block. In the past it has been customary to use an oil bomb torch for this work, but the inconvenience of this method together with the extremely sooty condition finally resulted in its being discarded in favor of clean and inexpensive electric heat.

OFFICE HEATING

Under the new NRA regulations a number of plants are operated only several days a week, while the offices of these plants are mostly always occupied the remainder of the week. In these cases it is often necessary to run the entire factory heating plant just to heat a few offices. Such expensive operation can easily be avoided by the installation of electric air heaters in these offices to keep them comfortable during the days when the factory heating plant is shut down. These heaters are also ready to be used for auxiliary heat on extremely cold days.

BREAD PROOFING BOXES

It is necessary to maintain certain humidities in bread proofing boxes, and one bakery owner was attempting to do this by evaporating moisture from a pan equipped with a gas burner. Results were not satisfactory because of the excess heat produced by the gas flame, and a 1 kw immersion heater was placed in the pan, giving perfect results. With the electric heater there is no excess heat to be given to the room, and evaporation of moisture takes place evenly and without contaminating the surrounding atmosphere.

SMALL UNIT HEATER MAILING CAMPAIGNS

If you have not already done so, now is the time to line up your mailing campaign for small industrial heating units. It has been proved that this direct mail literature as offered by the various manufacturers, and supplemented by your own if desired, produces definite results. The experience of a number of utilities indicates beyond a doubt that there are thousands of new applications for these small units, and to make the job easier the manufacturers of this equipment are offering a type and size for any kind of a job.

STEREOTYPE MELTING

A small printing company has recently electrified their stereotype melting pot by using a length of helicoil sheath wire coiled to fit their particular pot, and have found it the answer to their trouble. The unit is of 2500 watt capacity and has been operated very successfully in this particular case without temperature control. This type of unit that can be obtained in various wattages and lengths and coiled to fit practically any receptacle offers great possibilities in the soft metal melting field.

COMMERCIAL NOTES

(*Continued from page 3*)

bring results, and the Committee is hopeful present negotiations with the manufacturers will result favorably.

Rural Sales

The first issue of *Rural Electrification Exchange,* published by the Rural Sales Committee of which P. H. Powers, vice-president, West Penn Power Company, Pittsburgh, Pa., is chairman, was distributed earlier this month. On the mailing list are included rural sales representatives of utility companies and any such representative not receiving copy should communicate with the Commercial Department, Edison Electric Institute, 420 Lexington Avenue, New York, N. Y.

National Electric Cookery Council

A record range year is expected in 1934, with greater numbers of outlets and wider utility interest in the development of the electric cooking load. A broad advertising and publicity program is now under preparation to be presented at the next meeting of the Range Division of N.E.M.A.

Better Light, Better Sight

Reports from the field reveal most gratifying results from the Lighting Program conducted by the Lighting Sales Committee of which Mr. M. E. Skinner is chairman. From Coast to Coast small companies as well as the large ones placed special emphasis on sales of lamps and equipment, and most encouraging were the general educational and promotional campaigns conducted by some of the leading utilities for the advancement of better illumination for utilitarian purposes, and the protection of eyesight.

Outstanding in the commercial field of illumination was the advertising program inaugurated, and now being conducted by Hotels Statler on "Certified Lighting" which was outlined in the December Bulletin. In recognition of this progressive development, the New York Section of the Illuminating Engineering Society held its January meeting at Hotel Pennsylvania, at which meeting the complete Statler program was discussed, followed by inspection of a typical section of the Hotel. Among the speakers were Frank A. McKowne, president, Hotels Statler Company, and George E. Whitwell, Chairman, Sales Committee of the Institute.

The well known magazine, *Factory Management,* will have a special edition on BETTER LIGHT, BETTER SIGHT in March.—C. E. G.

POWER SALES ITEMS

AIR CONDITIONING

"Survey by Utility Company Shows 18,860 Tons Refrigeration for Air Conditioning in Chicago." Heating, Piping and Air Conditioning, January, 1934, p. 11. Keeney Publishing Company, 1900 Prairie Avenue, Chicago, Ill.

A survey just completed by the air-conditioning department of the Commonwealth Edison Company, of which G. A. Freeman is the manager, shows a total refrigeration capacity of 18,860 tons installed for air conditioning a variety of buildings in Chicago proper. Types of installations classified in the listing include banks, brokers' offices and exchanges, beauty shops, churches, civic buildings (Planetarium and Art Institute), clubs, dance halls, dentists' offices, drug companies, hospitals, hotels, industrial applications (candy, bakeries, printing, miscellaneous), general offices, and office buildings, packing plants, ticket offices, private offices, restaurants, stores (candy, clothing and shoe, food, miscellaneous), studios, trade association offices, undertakers, theaters, and residences.

"86 Shops at Radio City Air Conditioned." Heating, Piping and Air Conditioning, January, 1934, pp. 12-13. Keeney Publishing Company, 1900 Prairie Avenue, Chicago, Ill.

In the R C A Building at Rockefeller Center, New York City, some eighty-six high-grade shops of every description are air conditioned. Twenty-five of the shops are in the concourse, thirty-seven on the ground and twenty-four on the mezzanine. Their rentable area totals 103,405 sq. ft. and the interconnected pedestrian lanes or corridors are well over three-quarters of a mile in length; it has been estimated that well over 200,000 people will pass through these corridors daily and view the merchandise displayed.

"Air Conditioning Sells," J. P. Minnich, Metropolitan Edison Company, Reading, Pa. Electrical World, Vol. 102, No. 10, September 2, 1933, pp. 300-303. McGraw-Hill Publishing Co., Inc., 330 West 42nd Street, New York City.

"Heat from Lighting As An Air-Conditioning Load," Walter Sturrock and J. H. Walker (General Electric Company and Detroit Edison Company, respectively). Electrical World, Vol. 102, No. 12, September 16, 1933, pp. 377-379. McGraw-Hill Publishing Co., Inc., 330 West 42nd Street, New York City.

"Electric Heat for Humidity Control in Sugar Storage Warehouse," Delton T. Waby, Public Service Company of Northern Illinois, Chicago. Electrical World, Vol. 102, No. 13, September 23, 1933, pp. 409-410. McGraw-Hill Publishing Co., Inc., 330 West 42nd St., New York City.

COST ANALYSIS

"Power and Heat Cost Analysis for Industrial Plants," Louis A. Offer. Combustion, December, 1933, pp. 39-42. Combustion Publishing Co., Inc., 200 Madison Avenue, New York City.

The importance of accurate plant records in reducing power costs is discussed in some detail with the recommendation that weekly or daily analysis form a part of the monthly record for the stimulation of improvements in operation.

"A More Accurate Comparison of Heating Costs," F. M. Scott (In Collaboration with R. W. Dawes). Buildings and Building Management, January, 1934, pp. 26-28. Porter-Langtry Company, Publishers, 139 N. Clark Street, Chicago, Ill.

A comparison of the relative heating efficiencies of plants in different buildings.

DAIRY ELECTRIFICATION

"Dairy Products Plant Saves by Centralized Operations," L. V. Glavinovich, Electrical Engineer, C. C. Moore & Company, Engineers, San Francisco. Electrical World, Vol. 102, No. 15, October 7, 1933, pp. 470-473. McGraw-Hill Publishing Co., Inc., 330 West 42nd Street, New York City.

DIESEL ENGINES

"To Drop Diesel Engines—Royal Mail Company Will Put Steam Turbines in Liners." (Wireless to The New York Times.)

London, Sept. 29—According to the Daily Herald, a change from Diesel to steam turbine engines is to be made in two liners of the Royal Mail Steam Packet Company on the South Atlantic route—the Asturias and Alcantara, built in 1925 and 1926, respectively. Installation of the newest form of steam turbines is to be effected at Belfast. This change in policy has been adopted, it is said, because of the great expense for operation and maintenance of the Diesel-engined liners.

"Competition from Diesel and Gas Engines," by F. E. Kruesi. Electrical World, December 23, 1933, p. 824. McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York City.

Some good advice to Power Sales Engineers in dealing with engine competition.

Diesel Power, December, 1933. Business Journals, Inc., 192 Lexington Avenue, New York City.

This issue is called the "Accessory Number" and is devoted to those auxiliary devices necessary for the correct installation and operation of a Diesel engine plant.

ELECTRIC STAIRWAYS

"Electric Stairways Speed Up Vertical Transportation," H. C. Hickock. Buildings and Building Management, January, 1934, pp. 24-25. Porter-Langtry Company, Publishers, 139 N. Clark Street, Chicago, Ill.

Description of the installation in the Marshall Field & Company store in Chicago.

ELECTRIC WELDING

"Electric Welding Suitable for Everdur." Electrical World, December 16, 1933, p. 786. McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York City.

This article is a brief discussion of welding Everdur electrically by means of both metallic and carbon electrodes.

"Finds Under-Water Welding Possible." Electrical World, December 9, 1933, p. 753. McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York City.

Recently discovered that arc may be directed and manipulated so as to produce high quality welds between totally immersed pieces of metal.

FAN MAINTENANCE

"Maintenance of Ventilating-Fan Drives," by Francis A. Westbrook. Electrical World, December 16, 1933, pp. 785-786. McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York City.

A discussion of silent-chain drives for ventilating fans in large vehicular tunnels.

INDUSTRIAL ELECTRIFICATION—SILK MILLS

"Revised Silk Mill Drive Brings Benefits," C. W. Turner, Sales Manager, Connecticut Power Company. Electrical World, Vol. 102, No. 14, September 30, 1933, p. 437. McGraw-Hill Publishing Co., Inc., 330 West 42nd Street, New York City.

ISOLATED PLANTS

"Famine in the Land of Plenty," L. E. Habben, Mechanical and Electrical Engineer, New York City. Power, Vol. 77, No. 11, November, 1933, pp. 582-584. McGraw-Hill Publishing Co., Inc., 330 West 42nd Street, New York City.

In collaboration with the manufacturers, a proposal was submitted whereby the entire installation could be paid for out of savings, and with no outlay by the owners.

"Minneapolis Building Installs Own Plant." Power, Vol. 77, No. 11, November, 1933, p. 603. McGraw-Hill Publishing Co., Inc., 330 West 42nd Street, New York City.

New installation evoking considerable interest and the results obtained may have a direct bearing upon the power policies of other building owners in the locality. Equipment installed is listed.

REVERSED REFRIGERATION CYCLE

"Refrigerator Provides Heat." Power, Vol. 77, No. 11, November, 1933, p. 605. McGraw-Hill Publishing Co., Inc., 330 West 42nd Street, New York City.

At the Ancoats Hospital, Manchester, England, advantage is being taken of the fact that a refrigerating machine supplies heat in convenient form for utilization. A methyl-chloride apparatus is operated to maintain a room temperature in one part of the hospital at about the freezing point, but the condenser of the machine, instead of being cooled in the open air, is enclosed in a duct. A fan provides a draft through the duct, and the effluent heated air is delivered to the hospital linen cupboards for drying purposes. Cost of heating and refrigeration is proportionately lower than if both functions of the cooling machine were not utilized.

The Industry at the Beginning of Another Year

(*Continued from page 1*)

years of active and well directed effort to push forward technical developments in the art of rendering electric service and to promote the use of electricity. Their record of rate reductions over a long period of years is sufficient proof of the fact that they have been fair in passing on to their customers the benefits derived from these new developments and from improved operating methods.

Private enterprise in the conduct of business, by comparison with business conducted by governmental agency, has the great advantage of initiative. This advantage goes far toward offsetting many of the unfair advantages which government takes to itself in competing with private business, and over a period of years will surely assert itself, as has so often been demonstrated. So long as each individual company continues to do a better job of rendering electric service than any other organization is capable of doing, it may confidently be expected that electric light and power companies will continue to sell the great bulk of electricity used in the United States.

Pub. No. A7—Stoker Equipment and Furnaces—Errata Notice

The following correction is called to the attention of those having copies of E.E.I. Publication No. A7 "Stoker Equipment and Furnaces."

Pages 10 and 11—List of Recent Installations—Under *Industrial Plants* division, installation of Keasby & Mattison Company, the tabulation lists "Maximum B.t.u. per cu. ft. of volume" as 29,400 and "Furnace Volume" as 2030. The correct figures are 71,300 and 800 respectively.

It is suggested that corrections be made in the report, as given above, and that this notice be clipped and attached to the report as authority for the changes made.

EDISON ELECTRIC INSTITUTE BULLETIN, January, 1934

CONTENTS OF THIS ISSUE

The Electric Light and Power Industry at the Beginning of Another Year *By George B. Cortelyou* 1
Municipal and Private Electric Plants—1932 2
New Rates for Domestic Electric Service *By F. A. Newton* 4
U.R.C. Type Weatherproof Wire for Overhead Conductors 5
Chairman Davidson Reviews Past Year's Activities of Electric Refrigeration Bureau 7
Accomplishments in Rural Electric Development by Alabama Power Company During 1932 9
Overcoming Danger from Transformer and Oil Circuit Breaker Fires *By G. S. Diehl and W. T. Crook, Jr.* 19
Shielding of Ground Return Circuits 27
Electric Welding Standards 27
Power Companies Invited to Compete for Coffin Award 28
J. F. Fogarty Elected President The North American Company 28
Frank L. Dame—Obituary 29
Industrial Heating News 30
Power Sales Items 31

CONVENTIONS AND MEETINGS

JANUARY

22-25 Society of Automotive Engineers, Detroit, Mich.
23-26 American Institute of Electrical Engineers, New York, N. Y.

FEBRUARY

5-8 American Society of Heating and Ventilating Engineers, Hotel Biltmore, New York, N. Y.

MARCH

6-7 Oklahoma Utilities Association, Mayo Hotel, Tulsa, Okla.

MAY

1-4 Chamber of Commerce of the United States of America, Washington, D. C.
14-18 National Fire Protection Association, Haddon Hall, Atlantic City, N. J.
24 National Board of Fire Underwriters, Waldorf-Astoria Hotel, New York, N. Y.

JUNE

4-7 Annual Convention, EDISON ELECTRIC INSTITUTE, Traymore Hotel, Atlantic City, N. J.
18-21 National Association of Purchasing Agents, Hotel Cleveland, Cleveland, Ohio.
25-29 American Institute of Electrical Engineers, The Homestead, Hot Springs, Va.

HOW TO *EARN* A HAPPY NEW YEAR

Home electrification to raise the standard of living
Approaching the task through intense local market study of the
Power to buy, home ownership status, the human equation.
Pushing the major load builders to entrench the Electric Kitchen,
Yet not neglecting small heating and motor driven services appealing to small income groups.

National and local coordinated sales and promotional programs
Enthusiastic participation by utilities and local trade groups in selling,
With greater customer benefit from household electric equipment the paramount objective.

Yearnings for greater electric revenue can be satisfied only by
Executive order for energetic and double-barrelled sales action coupled with
An urge to do new promotional things in new ways and of course with
Rates in force economically promotional for each service rendered through appliances.

C. E. Greenwood

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